Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Preserving the Open Internet	)	GN Docket No. 09-191
	)	
Broadband Industry Practices	)	WC Docket No. 07-52

COMMENTS OF CTIA – THE WIRELESS ASSOCIATION®

Michael F. Altschul
Senior Vice President and General Counsel

Christopher Guttman-McCabe
Vice President, Regulatory Affairs

David J. Redl
Director, Regulatory Affairs

CTIA-The Wireless Association®
1400 Sixteenth Street, NW
Suite 600
Washington, DC 20036
(202) 785-0081

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SUMMARY

The wireless industry has consistently and decisively demonstrated the innovative, competitive, consumer-oriented nature of the wireless broadband ecosystem and the tremendous role it plays in the U.S. economy and in American life. Despite a voluminous record demonstrating that competition, not regulation, drives the success of this industry, the Commission has sought comment on issues that it perceives to have been "under-developed" in its recent Open Internet proceeding. CTIA disagrees strongly that the record as it pertains to the successful and vibrantly competitive wireless marketplace is under-developed. As CTIA has asked throughout this proceeding, exactly what is the harm that these rules are intended to address? Where in the wireless ecosystem is there a consumer access or technology innovation problem? Instead, the wireless industry has recounted in a variety of Commission proceedings the choices and innovations that take place every day to the benefit of consumers. Consumers are not being prevented from accessing the "free and open Internet" over wireless networks, and in fact the imposition of regulation in this area would undermine the success of the wireless broadband platform. Nonetheless, CTIA takes this opportunity to once again demonstrate the success of the wireless industry and the risks posed by regulation in this space.

First, there continues to be no need for the "any device" requirement called for by net neutrality advocates. This advocacy ignores technological and marketplace realities. Indeed, today there is an unprecedented level of competition in the mobile device market, substantial innovation in wireless broadband networks, and a trend toward network openness in the absence of regulation. Further, as detailed in the attached paper by Dr. Charles Jackson, devices and networks have become so intertwined that an "any device" rule is even less technically feasible than when initially proposed.

Second, Commission action in the wireless application market is clearly inappropriate and unnecessary in light of the tremendous success that has been achieved by this new market. The application market has experienced explosive growth and tremendous innovation in its short existence, and has done so in the absence of Commission intervention. This segment of the wireless broadband ecosystem – which has a consumer-facing element like the carrier segment – should be treated the same as the carrier segment. No regulation is necessary.

Third, CTIA cautions the Commission that its contemplated micromanagement of "specialized services" is ill-advised and outside the Commission's legal authority. "Specialized services" represent any number of business practices by wireless providers that bring benefits to consumers and businesses alike. Innovative business models like Amazon's Kindle and the Barnes and Noble Nook are two prominent examples of "specialized services" offered by wireless providers. Should the Commission attempt to regulate in this area, it runs the risk of undermining the significant benefits of these services and doing so outside its statutory authority.

Fourth, CTIA notes that for wireless networks to operate to the benefit of consumers, network operators must have the flexibility to constantly evolve the management of their networks to optimize performance. This flexibility is particularly important in light of the current scarcity of spectrum for wireless broadband services. In its *Further Inquiry*, the Commission suggests that recently-introduced usage-based data plans will mitigate the need for network management. This is simply not true. The reality of mobile wireless broadband networks is that any number of subscribers – none of whom are approaching the limits of their purchased data plans – can place incredible demands on the network by requesting data sessions simultaneously. If anything, usage-based pricing has sought to make wireless broadband more

accessible and more widely adopted, further exacerbating the already critical need for additional spectrum and network management flexibility.

Finally, as CTIA and others have detailed for the Commission, the agency lacks the legal authority under the Communications Act (or any other Federal law) to dictate the manner in which wireless providers provision service on their networks. Efforts to cabin a provider's discretion to manage its network would necessarily interfere with the information-processing aspects of broadband service: to conduct such management, providers must examine markers and other information associated with the packets at issue and act immediately upon those packets based on the information discovered. And, regulating the manner in which wireless providers provision service would be inconsistent with Congress's mandate that the Commission apply a light regulatory touch to wireless and broadband Internet access services.

Rather than adopt regulations that fly in the face of the technical and marketplace realities of today's thriving wireless ecosystem, the Commission would best serve the public interest by continuing to apply a light regulatory touch to wireless broadband services.

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COMMENTS OF CTIA – THE WIRELESS ASSOCIATION®

CTIA – The Wireless Association® ("CTIA") hereby submits these Comments in response to the Commission's Public Notice ("*Further Inquiry*") seeking comment on "under-developed" issues in its ongoing Open Internet proceeding.[1] Specifically, the *Further Inquiry* requests comment on transparency principles, a possible requirement that wireless providers allow any "non-harmful" device to attach to their networks, and possible Commission action in the wireless application environment.[2] The Commission also seeks comment on possible actions with regard to specialized services. As an initial matter, these issues are far from under-developed; CTIA alone has filed hundreds of pages of comments demonstrating that net neutrality regulation such as that proposed by the Commission is inappropriate for the dynamic, innovative, and consumer-oriented wireless broadband ecosystem. The record is replete with similar findings and arguments made by a broad cross-section of the wireless industry and devoid of any examples of wireless broadband provider conduct to justify regulation. The Commission should abandon its unwarranted and legally unsupportable attempts to regulate the provision of wireless broadband service.

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1 *Further Inquiry Into Two Under-Developed Issues in the Open Internet Proceeding*, Public Notice, GN Docket No. 09-191, WC Docket No. 07-52 (Sept. 1, 2010) ("*Further Inquiry*").

2 *Id.* at 5.

Indeed, the Commission itself has already noted the unique challenges posed by application of its proposed rules to wireless. CTIA has provided documented evidence that wireless broadband networks are fundamentally different, in terms of the competitive environment that wireless providers face, the technology utilized, and the services provided. CTIA and others have also noted numerous times before the Commission that no market failure justifying intervention in the wireless broadband market has been shown by either the Commission or by proponents of net neutrality regulation. The record demonstrates that consumers are not being prevented from accessing the "free and open Internet" over wireless broadband services and, as such, the rules under consideration in the Commission's Net Neutrality NPRM and those contemplated by the *Further Inquiry* should not be applied to wireless networks.

I. A COMMISSION MANDATE TO REGULATE DEVICE ATTACHMENT TO WIRELESS NETWORKS IGNORES TECHNOLOGICAL AND MARKETPLACE REALITIES.

The *Further Inquiry* contemplates the adoption of a mandate permitting consumer attachment of "non-harmful" devices to wireless networks.[3] Since 2007, net neutrality advocates have been calling for Commission application of the wireline *Carterfone* rules to wireless networks.[4] CTIA has long opposed such a mandate as incompatible with the realities of wireless networks and as antagonistic to innovation.[5] In the intervening three years since Skype filed its Petition to apply *Carterfone* rules to wireless, wireless networks and the devices that operate on

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[3] *Id.*

[4] Petition to Confirm a Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks, Skype Communications S.A.R.L., RM-11361 (filed Feb. 20, 2007) ("*Skype Petition*").

[5] Opposition of CTIA – The Wireless Association®, RM-11361 (filed April 30, 2007) ("CTIA Skype Opposition").

them have become increasingly intertwined, and innovation at every level of the wireless marketplace is thriving. There is simply no policy or technical basis for application of *Carterfone* rules to wireless networks (just as there was none when the Skype Petition was first filed),[6] and the Commission should not take action to upset the technological, economic, and consumer benefits the wireless industry brings to Americans.

A. There Is No Policy Basis for Application of the *Carterfone* Rules to Wireless.

Three years ago, in its opposition to Skype's Petition for Declaratory Ruling seeking to apply *Carterfone* to wireless, CTIA demonstrated that the rationale underlying any application of the Commission's *Carterfone* rules to wireless is defective. In the intervening years, this has become even more true, as significant evolutions in the wireless industry have made the wireless ecosystem even more competitive and innovative than in 2007.

Central to the Commission's *Carterfone* decision was the fact that at the time, AT&T was a rate-regulated monopolist in the telephone communications market and this market was vertically integrated, with AT&T selling CPE in competition with other downstream firms.[7] CTIA previously noted, however, that "the wireless industry is not dominated by a rate-regulated monopoly provider, wireless carriers do not manufacture the handsets they sell, and the market for the production of mobile wireless handsets is both competitive and innovative without regulatory intervention."[8] Wireless service is roughly analogous to wireline "party line" service in that the resource being used—spectrum—is shared by all those using the service

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6 *See* Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-11361 (July 15, 2009), attached as Attachment A (detailing the flaw in Skype's analysis of the CMRS market absent *Carterfone* regulation).

7 *See In re Use of the Carterfone Device and Message Toll Telephone Service*, Decision, 13 FCC 2d 420 (1968).

8 CTIA Skype Opposition at 30.

simultaneously. The "party line" service was excluded from the *Carterfone* rules. As detailed below, wireless consumers use spectrum in a complex shared environment and the application of the Part 68 connection rules to wireless would be a detriment all wireless users.

Three years ago, Skype argued that wireless carriers were limiting the ability of subscribers to operate wireless devices and run applications of their choosing and that only regulation could "liberate software innovation and free equipment manufacturers from unreasonable control by carriers."[9] Skype further alleged that carriers were engaged in anticompetitive behavior and that consumers would be unable to attach non-harmful devices to wireless networks absent Commission intervention.[10] In the three years since CTIA submitted its opposition to the Skype Petition, the wireless industry has evolved significantly, advanced technologically, and rolled out innovative service offerings. CTIA's observations regarding competition and innovation in the wireless space in general and the handset market in particular have borne out.

Since 2007, the wireless industry has seen tremendous technological advances, both in the evolution of wireless networks and the introduction of innovative consumer equipment. Wireless companies invest tens of billions of dollars annually in next generation networks that bring broadband to the person, whenever and wherever they desire it. AT&T, Verizon Wireless, and Cox Communications have all announced current or future 4G deployments using Long Term Evolution ("LTE") technology.[11] Verizon Wireless plans to roll out its LTE network to 30

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9 *Skype Petition* at 6.

10 *Id.* at ii.

11 Press Release, GSMA, China Telecom, KDDI and Verizon Wireless Join the GSMA as Mobile Operators around the World Commit to LTE (Feb. 15, 2010), *available at* http://news.vzw.com/news/2010/02/pr2010-02-13a.html; Press Release, AT&T, AT&T Announces Plans to Open Innovation Centers to Spur Development of New-Generation Mobile and Wired Broadband Applications, Devices (Feb. 18, 2010), *available at*

U.S. cities by the end of 2010 and deliver LTE to the entire country by 2013.[12] Last month, MetroPCS launched its 4G wireless network in Dallas, TX and expects that most of the company's markets will be covered by the end of this year.[13] Clearwire, meanwhile, has launched 4G service in 54 markets across the United States and plans deployments in New York City, Los Angeles, San Francisco, Denver, Minneapolis, Miami, Cincinnati, Cleveland, and Pittsburgh by the end of 2010.[14] Carriers and manufacturers also continue to provide new services by building out and upgrading existing 3G networks through evolutions of the HSPA and EV-DO technologies that already serve U.S. wireless broadband customers, and many have made substantial enhancements to their networks in 2010.[15]

In tandem with advancements in wireless networks, robust competition has spurred the availability of a diverse array of mobile devices and handset features. There currently are more than 630 devices manufactured for the U.S. wireless market by at least 32 manufacturers, far

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http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30536&mapcode= ("With commercial deployment of LTE scheduled to begin in 2011, AT&T's time line aligns with industry expectations for development of the technology and widespread availability of equipment and compatible LTE mobile devices."); Press Release, Cox Communications, Cox Successfully Demonstrates the Delivery of Voice Calling, High Definition Video Via 4G Wireless Technology (Jan. 25, 2010), *available at* http://cox.mediaroom.com/index.php?s=43&item=469.

[12] Wayne Rash, Verizon Wireless to Launch 4G LTE Service in 30 U.S. Cities, eWeek (Sept. 15, 2010), *available at* http://www.eweek.com/c/a/Mobile-and-Wireless/Verizon-Wireless-to-Launch-4G-LTE-Service-in-30-US-Cities-417341/.

[13] Victor Godinez, MetroPCS Launching High-Speed 4G Wireless Network Today In Dallas-Ft. Worth, The Dallas Morning News (Sept. 29, 2010), *available at* http://www.dallasnews.com/sharedcontent/dws/bus/ptech/stories/DN-metropcs_29bus.ART.State.Edition1.2492a9e.html.

[14] Press Release, Clearwire Corp., Clearwire Brings the Magic of CLEAR4G to Orlando (Sept. 20, 2010), *available at* http://newsroom.clearwire.com/phoenix.zhtml?c=214419&p=irol-newsArticle&ID=1472664&highlight=.

[15] *See* Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 09-51 (Feb. 12, 2010).

more than in other countries.[16] Smartphones continue to grow in popularity: 31 percent of all handset sales were smartphones by the fourth quarter of 2009,[17] and 61.2 million smartphones and wireless-enabled PDAs were reported active on carriers' networks at the end of June 2010.[18] PC cards, netbooks, and tablets are increasingly being adopted by consumers. For example, the Apple iPad, which includes access to the Internet and Apple's application store through a 3G or Wi-Fi connection, experienced immediate popularity – Apple sold its three millionth iPad just 80 days after its U.S. launch.[19]

The volume of manufacturers producing handsets sold in the United States has ensured continued robust competition in the handset market. As Verizon Wireless has observed, "established and new manufacturers face few, if any, impediments to entering the market or growing market share by offering devices that satisfy consumer demand."[20] And no wireless service provider in the U.S. manufactures wireless devices itself or owns equity in any of the major manufacturers,[21] further demonstrating the inapplicability of *Carterfone* to wireless.

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16 *See* Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 09-51, at Attachment: Handset Innovation (Aug. 14, 2009).

17 Press Release, The NPD Group, Smartphones Drive More Handset Overall, But Lower Prices Stall Total Handset Revenue Growth (Mar. 17, 2010), *available at* http://www.npd.com/press/releases/press_100317.html.

18 *See e.g.*, Press Release, CTIA – The Wireless Association® Releases Semi-Annual Survey on Wireless Trends (October 6, 2010), *available at* http://www.ctia.org/media/press/body.cfm/prid/2021 (last accessed October 12, 2010). See also Robert F. Roche and Liz Dale, CTIA's Wireless Industry Indices, Semi-Annual Data Survey Results: A Comprehensive Report from CTIA Analyzing the U.S. Wireless Industry, Mid-Year 2010 Results at 11 (forthcoming) (*CTIA Mid-Year 2010 Wireless Indices Report*).

19 Press Release, Apple Inc., Apple Sells Three Million iPads in 80 Days (June 22, 2010), *available at* http://www.apple.com/pr/library/2010/06/22ipad.html.

20 Comments of Verizon Wireless, WT Docket No. 10-133, at 97 (July 30, 2010) ("Verizon Wireless 15th Competition Report Comments").

21 *Id.* at 987

Contrary to Skype's predictions, carriers have continued to evolve their service offerings to meet consumer demands and take advantage of new technologies without regulatory intervention. As a result of intense competition, service providers have reduced prices, introduced innovative new service options, and enhanced the capabilities of their networks and devices. During the first month of 2010, Verizon Wireless, AT&T, and U.S. Cellular all reduced the price of their unlimited nationwide voice plans.[22] Multiple providers offer the flexibility of contract-free wireless service with unlimited talk, text, and data plans.[23] In early June, AT&T introduced a new series of broadband data plans that would, if customers choose to switch, reduce the monthly bill for 98 percent of the company's smartphone customers.[24] And, as CTIA has previously observed, network providers have undertaken numerous openness initiatives and

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[22] Press Release, U.S. Cellular, U.S. Cellular Offers New Unlimited National Calling Plans (Jan. 18, 2010), *available at* http://www.uscellular.com/uscellular/common/common.jsp?path=/about/press-room/2010/us-cellular-offers-new-unlimited-national-calling-plans.html; Press Release, AT&T, AT&T Announces New Unlimited Plans (Jan. 15, 2010), *available at* http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30401&mapcode=; Press Release, Verizon, Verizon Wireless Offers Simple, Affordable Convenience With New Unlimited Voice Plans, (Jan. 15, 2010), *available at* http://www.prnewswire.com/news-releases/verizon-wireless-offers-simple-affordable-convenience-with-new-unlimited-voice-plans-81687552.html.

[23] Press Release, Boost Mobile, Boost Mobile to Offer Handsets on Nationwide Sprint Network with 'Monthly Unlimited' Prepaid Plan (Jan. 7, 2010), *available at* http://www.boostmobile.com/about/mediacenter/news_releases/010710_handsets_monthlyunlimited.html; Press Release, MetroPCS Communications, Inc., MetroPCS Introduces Wireless for All Nationwide Service Plans with No Hidden Taxes or Regulatory Fees (Jan. 12, 2010), *available at* http://investor.metropcs.com/phoenix.zhtml?c=177745&p=irol-newsArticle&ID=1373920&highlight; Pocket Comm., No Contract Cell Phone Rate Plans, http://www.pocket.com/index.php/plans (last accessed October 1, 2010); Cricket Wireless, Cell Phone Plans, http://www.mycricket.com/cell-phoneplans?utm_source=DEF&utm_medium=1&utm_campaign=hero0048 (last accessed October 1, 2010).

[24] Press Release, AT&T, AT&T Announces New Lower-Priced Wireless Data Plans to Make Mobile Internet More Affordable to More People (June 2, 2010), *available at* http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30854. The plans also incorporate text notifications for data plans so that customers are aware as they approach their plan limits.

other efforts to open their networks to device and application developers.[25] Finally, as discussed in detail in Section II, *infra*, since 2007 there has been an extraordinary explosion in the development and deployment of application software stores. As such, Skype's arguments in favor of increased Commission regulation via device attachment rules were without basis in 2007 and are even less valid today in light of the significant advancements in the wireless ecosystem and resulting consumer benefits. The Commission should continue to allow competition and not regulation to drive innovation and investment in wireless services.

B. Proposals to Apply *Carterfone* Rules to Wireless Ignore Critical Technological Differences Between the Wireless and Wireline Environments.

Not only has the wireless marketplace continued to evolve in ways that benefit consumers and make "wireless *Carterfone*" an increasingly flawed concept, but also technological advancements have made such rules even more inappropriate now than when they were proposed by Skype in 2007. The technological complexities of the wireless world have no analog in the wireline context, and as such application of an "any device" rule would be incompatible with wireless broadband networks.

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[25] Reply Comments of T-Mobile USA, Inc., GN Docket No. 09-191, at 11-12 (Apr. 24, 2010) ("T-Mobile Net Neutrality Reply Comments") ("T-Mobile has been at the forefront of this trend, helping to create and leading in the implementation of the open Android platform—which now boasts over 40,000 applications. . . . In fact, like other providers, T-Mobile encourages and supports developers that seek to offer applications for use on a variety of handsets and devices."); *See also, e.g.*, Comments of Verizon and Verizon Wireless, GN Docket No. 09-191, at 28 (Jan. 14, 2010) ("Verizon Net Neutrality Comments") (Verizon Wireless' Open Development Program "encourages third-party developers to produce new devices and applications that can run on Verizon's networks," and its Joint Innovation Lab "will promote the development of new mobile technologies, applications, and services, with an initial focus on developing and deploying a mobile widgets platform to encourage innovative new mobile internet services."); Reply Comments of AT&T Inc., GN Docket No. 09-191, at 67-68 (April 24, 2010) ("AT&T Net Neutrality Reply Comments") (discussing various AT&T initiatives aimed at assisting developers in developing applications for AT&T devices); Comments of Sprint Nextel Corporation, GN Docket No. 09-157 at 28 (Sept. 30, 2009) (stating that Sprint Nextel embraces an "open ecosystem that encourages application developers to use Sprint Nextel's tools and programs to develop many applications for a wide range of Sprint devices").

In 2007, Dr. Charles Jackson wrote a paper highlighting the degree to which wireless handsets are integral parts of the networks on which they operate and noting that "wireless handsets present a great contrast to traditional telephone service and telephone instruments."[26] Dr. Jackson, in describing the "fundamental" differences between wired and wireless handsets, observed that:

> Most consumers of wired telephone service take that service from an established carrier that is subject to public utility regulation. The transmission facility, the wires to the home, is separate from the instrument. Just as it is easy to tell the difference between a power failure and a burnt-out light bulb, it is relatively easy to distinguish between problems in the wired network and problems in the wired telephone instrument—one can just unplug the instrument and plug in a second instrument that is known to work well. If the second instrument works when plugged into the problematic network connection, then the problem is in the first instrument. If the second instrument also fails, then the problem is in the network.[27]

Dr. Jackson's observation regarding wireline telephone equipment is simply inapplicable in the wireless context, which is significantly more complicated than the standardized world of Part 68 wireline devices. Licensed wireless devices are part of the wireless network itself, and "the performance of handsets has substantial static and dynamic efficiency implications for the operation of the network as a whole."[28] And, as CTIA has previously observed, this technical integration of wireless devices into the network is reflected in the Commission's rules, under which wireless devices are licensed to the network operator[29] and network operators have an

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[26] Charles L. Jackson, "Wireless Handsets Are Part of the Network" (Apr. 27, 2007), attached to CTIA Skype Opposition ("2007 Jackson Paper").

[27] *Id.* at 41.

[28] *Id.* at 1.

[29] *See, e.g.*, 47 C.F.R. § 1.903(a) (stating that stations in the Wireless Radio Services must be used and operated only with a Commission license, 47 C.F.R. § 1.903(c) (providing that a subscriber's authority to operate a device stems directly from the authorization held by the licensee providing service); *see also* 47 C.F.R. § 22.3 (requiring a valid license to operate cellular stations).

obligation to maintain control over the devices on their networks.[30] Indeed, a malfunctioning device can impair a wireless network, while a well-functioning device can actually improve network performance and the service available to other users.[31] For this reason, "carriers try to work closely with their handset partners to ensure that devices are optimized to provide service over the network using the least possible bandwidth."[32] Unlike in the wireline context, wireless broadband operators must manage devices that were not optimized for their networks and have the potential to degrade network performance.[33]

In the three years since Dr. Jackson completed his research paper on the integration of wireless devices with wireless radio access network, that level of integration has become much more complex. Dr. Jackson recently took a fresh look at his paper and updated it to reflect the realities of current generation wireless networks – which have come almost a full generation since his initial paper. Attached is Dr. Jackson's updated paper – "Wireless Terminals Are Part of the Network" – which details both the role of the wireless device in the network and spectrum management process and also the changes to the technology in the last three years. In sum,

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30 47 C.F.R. § 22.927. (providing that "[c]ellular system licensees are responsible for exercising effective control over mobile stations receiving service through their cellular systems").

31 *See, e.g.*, Declaration of Grant Castle, GN Docket No. 09-191, at ¶ 11 (Jan. 14, 2010) ("Castle Declaration") attached to Comments of T-Mobile USA, Inc., GN Docket No. 09-191 (Jan. 14, 2010) ("T-Mobile Net Neutrality Comments") ("In contrast to the wireline network, wireless networks are affected by the types of devices on the network and how they operate, because as devices communicate with the network, they consume network resources in ways that can be more or less efficient and that can affect other users more or less radically.").

32 T-Mobile Net Neutrality Comments at 23.

33 Comments of The GSM Association, GN Docket No. 09-191, at 17 (Jan. 14, 2010) ("Reducing network operator control over devices would reduce the efficiency of spectrum use and the level of coverage and quality of network service available to subscribers. Because they are core network devices, mobile handsets have the potential to create harmful interference and, unlike in the wireline context, could impact not only the user of the device, but also potentially other users on the network and users operating in other parts of the spectrum.").

wireless devices are now, more than ever, intertwined with the network for which they are designed.[34]

Wireless devices are designed to run on specific networks. The fact that both the GSM and CDMA platforms are in use in the United States presents compatibility issues that makes the use of a device on any wireless network impossible. Even within these air interfaces, differences present unique technical challenges to device portability. Carrier frequency allocations are not identical and neither are their chosen implementations of air interfaces: for example, some carriers have cellular licenses and others do not, some providers use the AWS band for 3G operations and others do not, and devices generally are designed to correspond with the spectrum resources of a particular operator. To pretend that any one device can be certified to run on any "technically compatible" network would ignore the fact that wireless devices are not fungible.

Google's Nexus One clearly demonstrates this issue. Google announced the Nexus One and began selling it as a subsidized, term-contract device on the T-Mobile network and as an unsubsidized, unlocked device capable of operation on other GSM-based networks. However, the Nexus One initially was not a 3G device on the AT&T network because it did not support the 850 MHz band that AT&T uses for 3G service. As a result, AT&T subscribers who chose to bring a Nexus One to the AT&T network were unable to access a 3G network.[35] The Nexus One example clearly demonstrates the close relationship between a device and the network on which it operates, the role this integration plays in device performance, and the consumer confusion that

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[34] Charles L. Jackson, "Wireless Terminals Are Part of the Network" (Oct. 12, 2010), attached at Attachment B.

[35] Marguerite Reardon, AT&T 3G Version of Nexus One Coming, CNET News (Feb. 1, 2010), *available at* http://news.cnet.com/8301-30686_3-10444986-266.html ("But the Android-based phone, which was launched last month, supports GSM radio frequency bands. The only 3G wireless bands that it supports are on T-Mobile USA's network. This means that customers wishing to use the 'unlocked' phone on AT&T's network can access only AT&T's 2.5G or EDGE network.").

will inevitably result from regulations that presumes that any wireless device will perform the same way on any network.

Finally, it is expected that next-generation networks will only increase the integration of devices into the network. As described in the attached technical paper, 3G and 4G wireless networks increasingly integrate the broadband transport and information processing layers in such a way that they cannot be separated for purposes of regulatory convenience without undoing a decade of wireless network innovation.[36]

II. COMMISSION ACTION IN THE WIRELESS APPLICATION ENVIRONMENT IS UNWARRANTED.

In its *Further Inquiry*, the Commission seeks comment on "how best to maximize consumer choice, innovation, and freedom of expression in the mobile application space, while ensuring continued private investment and competition in mobile wireless broadband services."[37] The simple answer is that this segment of the wireless broadband ecosystem – which has a consumer-facing element like the carrier segment – should be treated the same as the carrier segment. No regulation is necessary.

As with the wireless ecosystem in general, net neutrality rules are not necessary in the applications space, as there exists considerable innovation and growth in the absence of regulation. Indeed, the application environment is a relatively nascent, and rapidly growing, market segment. By any measure, the mobile application market is thriving. Wireless providers "continue to rapidly expand the already seemingly endless variety of applications

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[36] *See* John Marinho, "Wireless Transport Separation – Technical Facts" (July 15, 2010), attached at Attachment C.

[37] *Further Inquiry* at 5.

across many handset platforms."[38] Wireless consumers downloaded more than 1.1 billion apps in the U.S. in 2009, amounting to 24 percent of global downloads according to Strategy Analytics. It is estimated that wireless customers will download 1.58 billion apps in 2010.[39] Notably, North American consumers are the leading users of mobile applications, with North America accounting for 48% of global revenue in the mobile applications market.[40] Worldwide, the Gartner Group expects that consumers will download 4.5 billion applications worth $6.2 billion in 2010, and that they will download more than 21 billion applications worth nearly $30 billion by 2013.[41]

U.S. consumers have access to well over 300,000 apps that serve a variety of informational, public safety, and entertainment purposes. In its 2.2 years of existence, Apple's iTunes App Store reached 6 billion downloads, and it is projected that by the end of 2010 total application downloads will overtake total song downloads on iTunes.[42] The number of active applications and games offered by the Apple iTunes App Store shows the steady increase in application development, with nearly 270,000 applications and games available for download today.[43]

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38 Comments of AT&T Inc., WT Docket No. 10-133, at 50 (July 30, 2010) ("AT&T 15th Competition Report Comments").

39 "Mobile Applications: 2010 to 2014", Generator Research (Jan. 25, 2010).

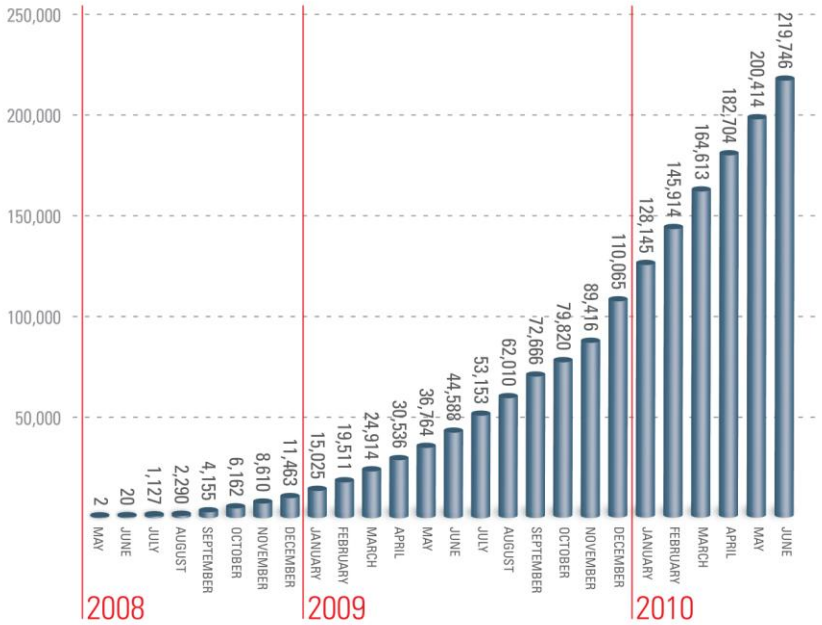
40 *Id.*

41 Press Release, Gartner Inc., Gartner Says Consumers Will Spend $6.2 Billion in Mobile Application Stores in 2010 (Jan. 18, 2010), *available at* http://www.gartner.com/it/page.jsp?id=1282413.

42 Athima Chansanchai, Apps Will Soon Overtake Songs on iTunes, MSNBC.com (Sept. 10, 2010), *available at* http://technolog.msnbc.msn.com/_news/2010/09/10/5085491-apps-will-soon-overtake-songs-on-itunes.

43 Apple iTunes App Store Metrics, Statistics and Numbers for iPhone Apps, at http://148apps.biz/app-store-metrics/?mpage=appcount.

Number of Applications Available in the Apple iTunes App Store



Source: 148apps.biz

There are now more than 130,000 applications and games available for download in the Android market, up from 50,000 in April 2010.[44] Consumers also have access to several other application stores, each of which offers an ever-increasing selection of applications. These application stores include the BlackBerry App World, Nokia Ovi Store, and the Windows Mobile Marketplace. Indeed, competition in the application market can be credited with further spurring already robust competition among carriers on handset selection and network quality.[45] And as

[44] AndroLib, http://www.androlib.com/appstats.aspx. *See also* Comments of CTIA – The Wireless Association®, WT Docket No. 10-133, at 29 (July 15, 2010).

[45] Reply Comments of AT&T Inc., WT Docket No. 10-133, at 13 (Aug. 16, 2010) ("At the same time, device manufacturers are competing vigorously to develop and deploy the next game-changing device, and developers continue to roll out thousands upon thousands of innovative applications further spurring consumer demand for the best handsets and the best networks,

Verizon Wireless has observed, there are few, if any barriers to entry for third-party developers, and "[b]ecause barriers to entry are low and the potential for returns is high, smaller developers generally stand on equal footing with larger ones. Notably, this open environment for application development was accomplished without regulatory intervention."[46]

The Commission also seeks comment on the restriction of "web-based applications" and whether a mobile provider should have more discretion to restrict consumers' downloading and/or use of native applications than they should with respect to web-based applications.[47] CTIA assumes that the Commission is referring to web sites that emulate the look and feel of native applications through web-standard languages such as Java, AJAX, and HTML 5. If that is the case, CTIA reiterates that neither the Commission nor any commenters to previous notices can show examples of wireless broadband provider conduct preventing customer access to particular Web sites. In the absence of such activity, regulation of conduct with respect to "web-based applications" is without merit.

In sum, the incredible success of the mobile application market during its short existence shows that this area of the wireless ecosystem will thrive without Commission regulation, and that the Commission can best achieve its policy goals by allowing the free market to drive innovation in this space.

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while providers seek to offer customers an increasing array of devices with access to these applications.").

46 Verizon Wireless 15th Competition Report Comments at 117-118.

47 *Further Inquiry* at 6.

III. THE COMMISSION'S CONSIDERATION OF "SPECIALIZED SERVICES" SHOULD RECOGNIZE THE INTEGRATION OF NETWORKS AND SERVICES AS WELL AS THE UNIQUE SERVICES OFFERED OVER WIRELESS BROADBAND NETWORKS.

The Commission also seeks comment on "how to maintain the investment-promoting benefits of specialized services while protecting the Internet's openness."[48] The Commission's analysis is generally concerned with differentiating broadband Internet services and "specialized services" for purposes of net neutrality regulation.[49] The Commission appropriately inquires whether specialized services provided over mobile wireless platforms raise unique issues.[50] Indeed, just as wireless networks are technologically very different than their wireline counterparts, specialized services provided over mobile wireless platforms raise unique issues that underscore the pitfalls of regulation in this area.

As CTIA has noted above, and as Dr. Jackson details in his attached paper, wireless devices are part of the network and their integration with wireless networks increases overall network efficiency. Indeed, "[c]arriers and manufacturers tend to collaborate in developing network standards, and then collaborate further to develop devices optimized to take advantage of the carrier's specific network features and upgrades. Close integration of the network and devices operating on the network can improve spectral efficiency and give the customer a superior experience."[51]

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48 *Further Inquiry* at 2. The previous Open Internet NPRM used the term "managed or specialized services" to describe the services referred to as "specialized services" in the Public Notice. *Id.* at n. 7.

49 *Id.* at 3-4.

50 *Id.* at 4.

51 AT&T Net Neutrality Comments at 179.

Additionally, and as CTIA and others have also detailed for the Commission, wireless networks cannot be easily separated into transport and information layers. Indeed, in some cases such a separation is impossible. 3G networks feature IP network management, adaptation, and conversion associated with the mobile environment to provide IP services between the wireline Internet and the mobile user, while 4G networks provide end-to-end IP services through the implementation of the Enhanced Packet Core.[52]

Because of the close integration of wireless devices into wireless networks and the integration of functions within wireless networks, the Commission's proposals with regard to "specialized services" are impractical in the wireless context. For example, the Commission contemplates a need to regulate the amount of network capacity that can be allocated to a specialized service.[53] Such regulation could quickly become problematic with regard to 4G networks that use VoIP for wireless calling. Under such a regime, would dedication of an entire cell's capacity during an especially busy calling period (such as a Presidential inauguration) violate an arbitrary Commission mandate for the amount of capacity that can be allocated to the "managed" VoIP service?

Further, the record in this proceeding has highlighted the success of unique business models, such as that employed by Amazon with its Kindle e-reader and Barnes and Noble with its Nook, under which the device manufacturer provides wireless broadband service at no cost to the end user without permitting access to the Internet. Not only have these devices and their

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[52] *See* John Marinho, "Wireless Transport Separation – Technical Facts", Attached at Attachment C.

[53] *Further Inquiry* at 2 ("Broadband providers may constrict or fail to continue expanding the network capacity allocated to broadband Internet access service in order to provide more capacity for specialized services. If this occurs, and particularly if one or more specialized services serve as substitutes for the delivery of content, applications, and services over broadband Internet access service, the open Internet may wither as an open platform for competition, innovation, and free expression.").

associated business models been wildly popular, but participants in this proceeding have also observed that such business models encourage bandwidth conservation.[54] The Commission makes no mention of how such unique and consumer-oriented services would be accounted for under contemplated regulation of "specialized services," and the record in this proceeding makes clear that permitting the continued existence of this model promotes the public interest.

Finally, the Commission has made no explanation of how the specialized services it proposes to regulate differ from services offered by caching providers. In both cases, content providers are paying for the ability to make their content load faster on end-user devices. Yet the Commission proposes to limit or regulate the adoption of specialized services by broadband providers, while leaving unregulated caching services that serve the same ultimate purpose.[55] Such services demonstrate the arbitrary nature of regulation of specialized services and the pitfalls of the Commission's proposal.

IV. THE PRESENCE OF USAGE-BASED PRICING BY SOME WIRELESS BROADBAND PROVIDERS DOES NOT MITIGATE THE NECESSITY FOR NETWORK MANAGEMENT, NOR DOES IT GRANT THE COMMISSION AUTHORITY TO SET RULES FOR MANAGING WIRELESS NETWORK CAPACITY.

In the *Further Inquiry*, the Commission asks several times about the impact of usage-based pricing models on the necessity of wireless broadband network management.[56] The

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[54] Comments of Qualcomm Incorporated, GN Docket No. 09-191, at 24 (Jan. 14, 2010) (stating that the "sponsored connectivity" model helps conserve bandwidth because consumers do not purchase "all-you-can-eat" data plans, which "by their very nature, encourage the consumption of bandwidth").

[55] Comments of Free Press, GN Docket No. 09-191, at 128 (Jan. 14, 2010) ("Nothing at all in the proposed rule would prohibit [Content Delivery Networks] and local caching services; indeed, such services are a more cost-effective and non-discriminatory way of achieving improved QoS on certain types of content.").

[56] *See, e.g.*, *Further Inquiry* at 4 ("The emergence of [usage-based pricing plans] may reduce mobile broadband providers' incentives to employ more restrictive network management practices that could run afoul of open Internet principles.").

Commission mistakenly suggests that the presence of such models will alleviate network congestion and mitigate the need for network management. Regardless of the innovative service and pricing offerings of wireless broadband providers, however, the amount of spectrum available to wireless providers remains insufficient to meet the needs of U.S. consumers absent management of this scarce resource. The adoption of usage-based pricing does not change the unique technical needs of wireless networks that require network management necessary to ensure continued customer satisfaction. The reality of mobile wireless broadband networks is that any number of subscribers – none of whom are approaching the limits of their purchased data plans – can place incredible demands on the network by requesting data sessions simultaneously.

Indeed, usage-based pricing, while certainly helping in managing capacity constraints on wireless networks, by itself it cannot remove the need for careful management of the wireless network. Usage-based pricing really has only served to allow more consumers to take advantage of the benefits of mobile broadband services, by lowering the cost of entry for the majority of wireless customers. For example, AT&T previously had single-level pricing for broadband wireless data services ($30 per month for unlimited data). But the introduction of tiered pricing has enabled the majority of subscribers access to the AT&T broadband data network for $15 per month.[57] But such a lowering of the entry costs also will increase wireless broadband adoption – driving further data usage by more wireless subscribers.[58] As such, without access to additional

[57] AT&T's $15 per month data plan provides 200 megabytes of data, which exceeds the average usage of 65 percent of AT&T smartphone customers. Press Release, AT&T, AT&T Announces New Lower-Priced Wireless Data Plans to Make Mobile Internet More Affordable to More People (June 2, 2010), *available at* http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=30854.

[58] *See* Andy Patrizio, AT&T Replaces Single Data Plan With Tiered Pricing Menu, EnterpriseMobileToday.com (June 2, 2010), *available at* http://www.enterprisemobiletoday.com/news/article.php/3885596/ATT-Replaces-Single-Data-

spectrum and the ability to carefully and efficiently manage their networks, wireless providers will not be able to deliver the mobile broadband experience expected by their customers.

The Commission's National Broadband Plan correctly recognized that additional spectrum is necessary for the United States to "keep[] pace with the global wireless revolution," and that a failure to allocate more spectrum for mobile broadband could result in "higher prices, poorer service, lost productivity, loss of competitive advantage and untapped innovation."[59] And the Obama Administration has recognized that "America's future competitiveness and global technology leadership depend, in part, upon the availability of additional spectrum."[60] CTIA applauds the Commission's efforts to implement its bold vision for wireless broadband. For now, however, spectrum scarcity "means carriers must exert control over the uses of the spectrum—or else face shortages or the complaints of consumers having dropped calls or connections."[61] Wireless providers must have the flexibility to engage in network management

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Plan-With-Tiered-Pricing-Menu.htm ("The new pricing plans are a smart move, according to Avi Greengart, research manager for mobile devices at Current Analysis. . . . In addition, Greengart believes this will open up smartphones to a much broader crowd. 'a lot of potential smartphone customers have been sitting on the sidelines because of the high cost of data plans. $15 for 200MB is enough if you want to check occasional e-mail or a Web page. For that class of user you will be able to stay within the limitations of the data plan. I think it will drive a lot of smartphone adoption,' he said."). *See also* Robert J. Shapiro, Tiered Data Plans Can Help Close Digital Divide, CNET News (June 24, 2010), *available at* http://news.cnet.com/8301-1035_3-20008763-94.html ("New analysis shows that as Internet providers ramp up their investments to accommodate the surge in bandwidth demand, the old, one-price-for-everybody model would slow our progress toward universal adoption, especially by lower-income Americans. . . . As with virtually every other good and service in our economy, those who consumer more bandwidth – or at least those who claim many times the bandwidth of the average Internet user – will have to pay a little more. Otherwise, the price for everyone else will increase so much that lower income Americans will be priced out of broadband.").

[59] Connecting America: The National Broadband Plan at 84-85 (2010) ("National Broadband Plan").

[60] Presidential Memorandum: Unleashing the Wireless Broadband Revolution (June 28, 2010), *available at* http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution ("Obama Wireless Memorandum").

[61] MetroPCS Net Neutrality Reply Comments at 24.

techniques, not only because "network management actually can be a tool for more efficiently utilizing spectrum,"[62] but also because limiting network management could "cripple [wireless providers'] ability to address capacity constraints and exacerbate the shortage of capacity for mobile broadband traffic."[63]

Additional spectrum, network management, and technological advances are all part of the comprehensive and complicated technical picture that wireless network engineers manage every day to ensure American consumers receive the highest quality wireless experience. While all three work together to increase the wireless broadband experience, one, taken alone, does not remove the need for the others. Put simply, "more spectrum is not a substitute for network management, and it makes no sense for the Commission to limit the latter when it knows the limited supply of the former is confronting wireless providers with increasingly severe challenges."[64]

Further, wireless networks have unique technical needs that are not impacted by the presence of usage-based pricing models. On a wireless network, the "number and mix of subscribers in a given area constantly changes – sometimes in highly unpredictable ways," which requires that wireless broadband operators "accommodate a constantly changing mix and volume of voice and data users and traffic at individual cell site locations."[65] There is no way to predict how many users will be sharing the wireless network at a particular cell site at a particular time, nor is there any ability to predict how these consumers will be using their devices. It is entirely

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62 Verizon Net Neutrality Reply Comments at 57.

63 CTIA Net Neutrality Reply Comments at 33.

64 AT&T Net Neutrality Reply Comments at 77-78.

65 Joint Declaration of Michael D. Poling and Thomas K. Sawanobori, GN Docket No. 09-191 at 16 (Jan. 14, 2010), Attachment E to Verizon Net Neutrality Comments ("Verizon Network Management Declaration").

possible that at a given time, the usage by consumers sharing the network at a cell site would overwhelm the cell site, even if every one of them had a wireless subscription limiting their monthly data use. For this reason, the adoption of usage-based pricing models does nothing to mitigate the need for network management.

As detailed in the attached technical paper, the argument that monthly data caps or tiered pricing mitigate the need for radio access network management conflates the idea of a monthly cap on total throughput with the demands on a network at a given moment in time. Essentially, this is the difference between allowing not more that 5 GB of total data in a month with the moment-to-moment determination of whether one user gets 5 Mb/s while others get none, or dividing the capacity of the cell into five 1 Mb/s users. They are discrete and different network management issues. Taken individually, one customer's use of a wireless broadband provider's radio access network is largely inconsequential. If there were no other considerations, network management and capacity concerns would largely slip away. However, there are more than 290 million wireless broadband users in the U.S. Differing tiers of service address periodic limits (often monthly) on overall consumption (minutes-of-use or Megabytes of data), but do not correspond to the real-time peak demand and load that may appear to a base-station or network element during times of peak consumption. To replace or supplant traditional network management functions based on tiered services would compromise overall network performance, increase technical risk and network complexity, and reduce the available capacity to support end-user demand.[66]

Finally, as CTIA and others have detailed for the Commission, the agency lacks the legal authority under the Communications Act (or any other Federal law) to dictate the manner in

[66] *See* John Marinho, "Wireless Broadband, Tiered Services and Network Management" (September 2010), attached at Attachment D.

which wireless providers provision service on their networks.[67] Efforts to cabin a provider's discretion to manage its network would necessarily interfere with the information-processing aspects of broadband service: to conduct such management, providers must examine markers and other information associated with the packets at issue and act immediately upon those packets based on the information discovered.[68] And, regulating the manner in which wireless providers provision service would be inconsistent with Congress's mandate that the Commission apply a light regulatory touch to wireless and broadband Internet access services.[69]

67 CTIA Net Neutrality Reply Comments at 54-62.

68 *Id.* at 83.

69 CTIA NOI Reply Comments at 39-42.

V. CONCLUSION

As has been demonstrated by CTIA in these Comments and by the plethora of filings in this and related proceedings, the question of whether net neutrality rules should be applied to wireless broadband and to "specialized services" operating on wireless broadband networks is far from "under-developed." Put simply, net neutrality regulation has no place in the highly innovative, robustly competitive, and consumer-oriented wireless broadband ecosystem. Not only is there no policy basis for regulation in this place, but the unique technical characteristics of wireless networks would make the Commission's contemplated regulation infeasible at best and would likely result in affirmative harm to consumers. As such, CTIA once again registers its strong opposition to the regulations proposed by the Commission.

Respectfully submitted,

By: */s/ David J. Redl*

David J. Redl
Director, Regulatory Affairs

Michael F. Altschul
Senior Vice President and General Counsel

Christopher Guttman-McCabe
Vice President, Regulatory Affairs

CTIA-The Wireless Association®
1400 Sixteenth Street, NW
Suite 600
Washington, DC 20036
(202) 785-0081

October 12, 2010

July 15, 2009

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

RE: *Ex Parte* Presentation RM-11361, WT Dkt. No. 09-66

Dear Ms. Dortch:

CTIA – The Wireless Association® ("CTIA") submits the following *ex parte* in response to the June 29, 2009 filing by Skype in the above-referenced docket.[1] Skype's latest submission consists of a 200-plus page montage largely consisting of self-serving press clippings that only underscore Skype's primary objective throughout this proceeding – to promote its own business model – even when the core premise of its Petition is fatally flawed. While paying lip service to the importance of "competition" and "innovation" in the wireless market, Skype ignores them both in seeking the application of monopoly-era regulation to the wireless market. This filing demonstrates why Skype's regulatory version of the wireless industry is not necessary, and highlights how the industry has evolved over the last two years since the Skype filing, without the need for intervention. As Blair Levin recently described in his presentation on the development of the National Broadband Plan, the Commission will analyze what would happen if the Commission does not act. This filing demonstrates the benefits of being cautious before regulating a competitive industry.

The *Carterfone* regime that Skype wants to foist upon competing wireless carriers was designed for a telecommunications environment in which a single, monopoly provider was sole owner of the only existing network and the monopoly device manufacturer. In today's wireless industry, by contrast, no carrier has more than 32% of the market nor does any carrier have an ownership interest in any of the 33 handset manufacturers currently serving the market.

In evaluating Skype's filing, CTIA believes it is useful for the Commission to consider what has occurred in the wireless market since Skype filed its *Carterfone* Petition and to compare Skype's dire predictions about the evolution of the wireless ecosystem without government intervention versus what CTIA said at the time:

[1] *See Ex Parte* Presentation of Skype Communications S.A.R.L., RM-11361, WT Dkt. No. 09-66 (filed June 29, 2009) ("*Skype Ex Parte*").

WHAT WAS SAID IN THE PAST

- In its Petition for Rulemaking in February 2007, **Skype** argued that wireless carriers were limiting the ability of subscribers to operate wireless devices and run software applications of their choosing.[2] **CTIA**, by contrast, asserted that the wireless industry was robustly competitive, with multiple wireless providers competing in every market and numerous equipment manufacturers providing devices to those providers.[3]

- **Skype** pointed to purported examples of wireless carriers' disabling access to Wi-Fi functionality,[4] locking handsets to a particular operator,[5] favoring a proprietary network model over open development platforms,[6] and adopting allegedly restrictive terms of service limitations on connections to the wireless network.[7] Skype argued that, without Commission regulation, consumers would be unable to attach non-harmful devices to wireless networks.[8] **CTIA** noted that there were any number of Wi-Fi enabled handsets at the time – contrary to Skype's assertion that Wi-Fi had been "crippled" by the wireless industry.[9] CTIA also demonstrated that carriers' customer service agreements vary significantly with respect to the terms and conditions governing the connection of devices to their networks.[10]

- **Skype** argued that, without Commission regulation, consumers would be unable to run the applications of their choosing.[11] According to Skype, regulation was essential in order to "liberate software innovation and free equipment manufacturers from unreasonable control by carriers…."[12] **CTIA** provided evidence of the vibrant, open and evolving market for software applications on wireless devices.[13]

In sum, in sharp contrast to Skype's missive to the Commission predicting vast consumer harms, CTIA urged the Commission to reject the Skype Petition as it presented solutions to problems that do not exist in the wireless market and suggested remedies that would not benefit consumers. *CTIA predicted that the competitive*

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[2] *See Petition to Confirm A Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks*; RM-11361 (filed Feb. 20, 2007) ("*Skype Petition*").
[3] *See* Opposition of CTIA – The Wireless Association ®, RM-11361 (filed April 30, 2007) ("*CTIA Opposition*").
[4] *See Skype Petition* at 14-15.
[5] *Id.*at 16-17.
[6] *Id.* at 19-20.
[7] *Id.* at 18-19.
[8] *See CTIA Opposition* at 2.
[9] *Id.* at 18-19.
[10] *Id.* at 21-22.
[11] *See Skype Petition* at 2.
[12] *Id*. at 6.
[13] *See CTIA Opposition* at 21-22.

wireless marketplace would continue to evolve to provide consumers with even greater choice, without the need for Commission intervention.[14]

Two years later, which of these competing visions of the future of the wireless marketplace has been borne out? In short, time has validated CTIA's assessment of the wireless market and discredited Skype's gloomy competing view. As Mr. Levin has proposed, the Commission can now analyze what has happened without FCC intervention.

WHAT HAS HAPPENED

- No dire results have occurred. Since February 2007, the wireless industry has continued to experience explosive subscriber growth (adding more than 40 million subscribers) while the price per minute for wireless service in the United States is the lowest of any of the 26 OECD countries measured. The level of consumer satisfaction also continues to improve. Consumer Reports, the magazine that is the flagship property of the wireless industry's harshest critic, Consumers' Union, said in its January 2009 issue that "[o]verall, wireless service has become significantly better," and that "[s]ixty percent of readers were either completely or very satisfied with their service."[15]

- In addition, mobile broadband offerings have expanded greatly, including in rural areas, and numerous carriers have announced plans to deploy next generation wireless broadband networks greatly surpassing the capabilities of existing networks.[16] Wireless carriers have established new calling plans, expanding the voice and data capabilities available to wireless subscribers at ever lower prices.[17] More than 630 unique wireless devices are manufactured

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[14] *See e.g., CTIA Opposition* at 49-50.

[15] "Best Cell Phone Service", Consumer Reports, Jan. 2009 *available at* http://www.consumerreports.org/cro/electronics-computers/phones-mobile-devices/phones/cell-phone-service-providers/cell-phone-service/overview/cell-phone-service-ov.htm (last accessed July 15, 2009).

[16] *See e.g.,* "Bluegrass Cellular Announces New 3G Coverage In Cumberland County," Press Release, Apr. 22, 2009, *available at* http://www.bluegrasscellular.com/about/news/bluegrass_cellular_announces_enhanced_voice_and_3g_coverage_in_grayson_coun (publicizing Bluegrass Cellular's decision to add 3G high speed data service coverage to Burkesville, KY); "Cellular South to Expand Availability of Advanced 3G Mobile Broadband Services Throughout Much of Mississippi; Next Generation Wireless Gives Customers Faster Internet Connections, New High-Speed Data Services and Multimedia Applications," Cellular South Press Release, Mar. 10, 2009, *available at* https://www.cellularsouth.com/news/2009/20090310.html (noting plan to introduce 3G service in 78 cities in the second and third quarters of 2009); "Stelera Wireless Launches Wireless Broadband Network; Cutting Edge Internet Services Launched In South Texas," Press Release, Mar. 23, 2009, *available at* http://dev.stelerawireless.com/Portals/0/docs/National%20STX%20Press%20Release.docx (touting its use of HSPA to build "a network optimized for the broadband experience").

[17] *See e.g.,* "Verizon Wireless Introduces New Unlimited Plans That Are as Worry Free as the Guarantee," Press Release, Feb. 19, 2008, *available at*

for the U.S. market. Contrary to what Skype predicted, there are now 29 devices with integrated Wi-Fi capability with many more on the way.[18] Further, counter to Skype's prediction, at least 54 unlocked handsets are currently available through third-party and manufacturer websites.[19]

- Counter to Skype's prediction about the lack of innovation in the application space, growth of wireless software applications has been even more pronounced. Apple iPhone, the Android system, Palm, Blackberry, Nokia and, shortly, Windows Mobile offer applications stores for wireless devices, which consumers have enthusiastically embraced.[20] There are now more than 70,000 applications available to wireless consumers that were not available when Skype made its dire prediction.

- Even the Skype application, whose availability and adoption Skype argued would languish in the absence of regulatory intervention, is now available for more than 100 wireless devices according to Skype's own website.[21] And Skype recently released a version of its application compatible with Windows Mobile 5.0 that should greatly expand the number of wireless devices on which the application is accessible.[22]

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http://news.vzw.com/news/2008/02/pr2008-02-19.html (announcing $99.99 Nationwide Unlimited Anytime Minute Plans, and enhanced Broadband Access Plans offering 50 MB a month for $39.99 or 5 GB a month for $59.99); "Cricket Wireless Offers Unlimited Data for $35 a Month, Look Ma, No Cap," Engadget Mobile, Mar. 3, 2008, *available at* http://www.engadgetmobile.com/2008/03/23/cricket-wireless-offers-unlimited-data-for-35-a-month-look-ma/; Phil Goldstein, **"**AT&T unveils $3 per day unlimited GoPhone calling plan," Fierce Wireless, May 8, 2009, *available at* http://www.fiercewireless.com/story/tunveils-3-day-unlimited-gophone-calling-plan/2009-05-08?utm_medium=nl&utm_source=internal (announcing AT&T Mobility's decision to launch a new calling plan through its prepaid GoPhone service, which will "give users unlimited calling with no roaming or long distance fees for $3 per day…customers using this new plan will also be able to get text messaging and data service at the same pay-per-use rates as all other GoPhone 'Pay As You Go' plans").

[18] CTIA Research as of April 6, 2009 and includes devices with Wi-Fi and/or UMA capability; *see also* "Sprint's Blackberry Tour to sprout WiFi Next Year", FierceWireless *available at* http://www.fiercewireless.com/story/sprints-blackberry-tour-sprout-wifi-next-year/2009-07-09 (last accessed July 10, 2009).

[19] CTIA Comments at 34.

[20] *See e.g.*, "Android | Market" *at* http://www.android.com/market/ (providing an overview of the available applications for Android phones); Palm Software, http://software.palm.com/us/html/top_products_treo.jsp?device=10035300025 (detailing the kind of software that can run on a Palm phone); Blackberry App World, http://na.blackberry.com/eng/services/appworld/? (listing all available applications for BlackBerry devices); "Skype 2.5 for Windows Mobile" *at* http://www.skype.com/download/skype/windowsmobile/ (demonstrating Skype's ability to utilize the Windows Mobile platform).

[21] *See* Skype, http://www.skype.com/download/skype/mobile/ (last accessed July 15, 2009).

[22] *See* http://www.skype.com/intl/en/download/skype/windowsmobile/ (last accessed July 6, 2009).

The explosive growth in wireless applications belies claims made in 2007 by Skype and its supporters

- Further, contrary to Skype's prediction, carriers continue to evolve their service offerings, and their terms and conditions, to match consumer demands and to take advantage of new network and handset capabilities.

In short, the regulatory requirements that Skype seeks to impose on the wireless industry are no more necessary today than they were when Skype filed its *Carterfone* Petition in 2007. Since the time of Skype's filing, the demand for wireless services, the diversity of wireless devices, and the availability of wireless software applications have grown exponentially. As the past two years have vividly illustrated, in this dynamic environment when consumers demand additional software, hardware capabilities and services, the wireless industry will meet those demands. The industry will continue to be responsive to consumers' needs without the unnecessary regulations sought by Skype.

CTIA believes that this constantly-evolving, financially-healthy, consumer-driven industry is exactly the place where the government should analyze what would happen without government intervention, before it moves down the path of regulation proposed by Skype. If you have any questions, please do not hesitate to contact me.

Sincerely,

/s/ Christopher Guttman-McCabe

Christopher Guttman-McCabe
Vice President, Regulatory Affairs
CTIA – The Wireless Association®
1400 Sixteenth Street, NW
Suite 600
Washington, DC 20036
(202) 785-0081

Dated: July 15, 2009

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that mandating the *Carterfone* regime on the wireless market was necessary because carriers "have imposed excessive burdens and conditions on application entry in the wireless application market, stalling what might otherwise be a powerful input into the U.S. economy." Tim Wu, "Wireless Net Neutrality: Cellular *Carterfone* on Mobile Networks," New America Foundation, Working Paper #17, at 2 (Feb. 2007). As Chairman Genachowski correctly observed last week, today's marketplace is "brimming with thousands of apps that have unleashed new waves of creativity and innovation …." Remarks of Chairman Julius Genachowski to the Staff of the Federal Communications Commission, at 2 (June 30, 2009).

Wireless Terminals Are Part of the Network

Charles L. Jackson

October 12, 2010

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1 Wireless Handsets and Network Neutrality

Wireless broadband service is a new service—still in the process of rapid technical evolution. Because of the rapid growth of the number of subscribers and their use of the service, wireless service providers are constantly building out and upgrading their networks. The wireless transmission facility—the radio paths to and from the base station—is created, in part, by the handset. Unlike the case in wired telephone service, the consumer cannot unplug the handset to test the line. With wireless, the handset and the wire are one and the same.

In the jargon of economists, handsets are both a *complement* to the network and a *substitute* for network investment. Handsets are part of the wireless network, and the performance of handsets has substantial static and dynamic efficiency implications for the operation of the network as a whole. Investments in handsets can increase network efficiency and thereby increase the productivity of network investment. Hence, a wireless service provider has a strong interest in controlling the technology used in handsets in order to create an efficient network as well to manage network evolution. Handset subsidies, bundling, and carrier programs for device certification are reasonably efficient tools for such control.

Closely related to efficiency concerns are social regulatory concerns. Bundling handsets with wireless service is a simple and efficient mechanism for ensuring that handsets have the technical characteristics needed to meet the FCC's regulatory requirements, to perform optimally on a given wireless network, and for reducing the incentives for theft.

2 Efficiency Advantages of Handset Bundling

There are a number of ways in which handset bundling in the provision of wireless services improves performance and lowers the cost of those services. Unlike the case in wired telephony, in wireless telephony the features and quality of the handsets used on the network can have a substantial impact on the cost and quality of the wireless service, not only for the individual subscriber but for all consumers. If John uses an inferior wireless phone—even if that inferior phone was state-of-the-art a few years ago—he may deny service to Mary who is sitting next to him or may degrade service for other users a

mile away. Widespread use of inferior handsets would substantially worsen wireless service—such as by increasing the number of coverage holes and dropped calls—or would require a significant increase in the capital plant used by wireless carriers. In either case, consumers would suffer. Wireless carriers have strong incentives to ensure that consumers use handsets that economize on total costs (capital costs and handset costs combined). In contrast, if one uses a poor quality wireline handset, it does not degrade one's neighbor's wireline telephone service. In the economist's jargon, poor-quality wireless handsets can create substantial negative externalities but poor-quality wireline handsets do not. (There is an exception to this general rule—wireline party line service in which one telephone line is shared by multiple subscribers. Failure of equipment of one subscriber on a party line can deny service to other subscribers. For this reason, the FCC never applied the *Carterfone* policy to telephones attached to party lines.)

The wireless industry has seen enormous innovation and technical advancement over the last three decades. Many of these innovations have made the networks more efficient—creating ways to work closer to the rigid limits on capacity imposed by the finite spectrum made available for wireless service. Innovations have also made new service capabilities, including data applications, available to consumers. These innovations require interaction between the network and handsets to an extent that is unparalleled in wireline telephony. Seeding the market with handsets providing expanded capabilities is an essential step in fostering the rapid adoption of more efficient or more capable wireless services. Adoption of capacity-expanding innovations would be far slower if carriers did not provide handsets supporting new capabilities. Similarly, the adoption of new services would also take longer absent carrier support of handset supply.

Summing up, multiple technical factors, with the most important probably being the fundamental role of handsets in determining overall system efficiency and capital costs, create strong, efficiency-serving incentives for wireless carriers to control the nature and characteristics of the handsets used by their subscribers. Below I consider a few of these handset characteristics in more detail.

2.1 Handset Attributes and System Capacity

High quality, more capable handsets can expand network capacity and coverage. This was less true for first-generation analog cell phones and for early GSM handsets than it is today. Several aspects of handset design in current 3G systems (CDMA-2000 and WCDMA) and 4G systems (LTE and WiMAX) affect system capacity. These include receiver sensitivity, the range of vocoder standards implemented in the receiver, antenna performance, MIMO capabilities, handset transmit power, and the use of header compression in IP/TCP sessions.

Many of the ways that handset capabilities can enhance or degrade system capacity are created by the increasing sophistication of wireless systems. Modern wireless systems can vary the amount of spectrum (bandwidth) and power used on the connection to a particular handset to match the particular conditions of that connection. Thus, if a user is on the edge of a cell, the system can devote more power for base station transmissions to that user and can switch to a more robust modulation (more bandwidth per bit). Similarly, if the user is on the edge of a cell, the system can allow the user's handset to transmit using a more robust modulation on the link back to the base station. Doing so uses more bandwidth per bit but permits the handset to transmit reliably over a longer distance. The first wireless systems, analog FM and early GSM, did not have comparable adaptive features. Every handset took the essentially the same share of system resources whether it was close to the base station or at the very edge of the base station's coverage.

One consequence of such adaptive features is that a flawed handset, such as a receiver with a less sensitive receiver or a defective antenna, may provide acceptable service in most circumstances because the network adapts to the handset's shortcomings. That is, the network devotes more of the resources under its control—base station power, downlink bandwidth, and uplink bandwidth—to communications to that flawed handset. Consequently, there are less of those resources left for other users. Conversely, a better than average handset frees up network resources for other users.

Below I consider some of these adaptive features in more detail.

2.1.1 Receiver Sensitivity

The sensitivity of the receiver in a wireless handset is a measure of the minimum useful signal—the weakest signal that can be received at an acceptable error rate. Receiver sensitivity is a handset feature that, if impaired, imposes costs on other users of the network. In CDMA systems, a base station transmits telephone calls to multiple subscribers using a single complex signal. That signal has fixed maximum power—typically near 20 watts. The base station divides that power among the various subscribers—transmitting to each subscriber at just above the minimum power needed to communicate with that subscriber. Consequently, base stations transmit at lower power to subscribers near the base station and at higher power to subscribers who are more distant or who are in hard-to-reach locations—such as deep inside buildings.[1] The 4G standards, LTE and WiMAX, also allow devoting additional resources to difficult connections.

Consider two handsets, A and B, identical in all respects except that handset B is less sensitive than handset A—specifically, handset B requires twice as much received power to perform acceptably. A CDMA base station designed to serve 20 simultaneous conversations to type-A handsets could serve only 10 simultaneous conversations to type-B handsets.[2] Looking at the problem another way, such a base station could serve 20 simultaneous conversations to type-B handsets only if those handsets were, on average, located closer to the base station. If one analyzes coverage using a simple and widely accepted model of radio propagation, one finds that a base station that could serve 20 type-A handsets spread over the area within one mile from the base station would be able to serve the same number of type-B handsets spread over an area about 30% smaller—the area within only 0.85 miles of the base station.[3] A wireless carrier could compensate for such a reduction in range by installing more base stations—in this case, approximately a

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[1] Handset sensitivity in CDMA systems provides a particularly clear example of a handset feature that, if poorly implemented, reduces the network performance for other subscribers. However, in the GSM standard there are handset options, such as the AMR vocoder, that if present and activated, permit a base station to serve more subscribers or serve subscribers at greater distances from the base station than would be the case otherwise.

[2] This example is simplified. Many CDMA voice systems are limited by capacity on the reverse (mobile-to-base) link not by forward link capacity. However, were the sensitivity impairments significant, forward-link capacity would become limiting. In the high-speed data service, EVDO, forward link capacity is often limiting.

[3] The analysis is based on using an inverse fourth-power propagation law. The reduction in spacing is actually by a factor of 0.8409.

30% increase in base stations would be needed. – at a much higher cost than more efficient devices for end-users. A 30% increase in the number of required base stations would, to a first approximation, result in a 30% increase in the capital cost of a wireless system and consequently would significantly increase the cost of wireless service.[4]

Closely related to sensitivity is the quality of the antenna on a handset. A poor antenna degrades handset performance in much the same way as does reduced sensitivity. Similarly, given that retractable antennas often fail, a service provider requirement that retractable antennas be field replaceable would make it easier for consumers to repair handsets with broken antennas. Easier repair would mean that fewer consumers will have handsets with defective antennas that consume excessive network resources.

2.1.2 Vocoder Performance

Perhaps the clearest example of handset capabilities substituting for network capabilities is the voice compression subsystem in the handset. This subsystem, known as the voice coder or *vocoder*, determines how many bits per second are generated to represent a speech signal. Continuing research has resulted in the development of vocoders that perform adequately using fewer bits per second than those originally used in CDMA and GSM. These better vocoders permit more subscribers to be served over a given number of radio channels. Thus, better vocoders expand system capacity at almost no cost and, if better vocoders are sufficiently low cost, widespread use of better vocoders would lower the total costs of wireless service.

The CDMA standard now includes vocoders called the Enhanced Variable Rate Coder (EVRC) and the Selectable Mode Vocoder (SMR).[5] The industry claims that the SMR vocoder increases system capacity by 34% while delivering the same quality as the EVRC vocoder.

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[4] The factor of two difference in sensitivity between two handsets discussed above is not an unreasonable difference from the point of view of practical receiver engineering. In late 2004, CTIA, the wireless industry association, filed with the FCC reports of recent tests of PCS handsets performed by independent laboratories. These tests showed, among other things, that the tested handsets were on average, able to pick up signals less than half as strong as the weakest signals that could be picked up by a handset just meeting the requirements of the industry standard.

[5] See http://www.cdg.org/technology/cdma_technology/vocoder/index.asp.

The GSM world has a similar variable rate capability called the adaptive multirate (AMR) vocoder. It allows the wireless system to adjust the traffic generated by the handsets to better match the system capacity. Use of the AMR vocoder also permits a carrier to serve mobiles at greater distance from a cell site or deeper inside office buildings than would otherwise be possible.

Adoption of these vocoders in wireless networks expanded capacity significantly. But, individual users had little incentive to purchase handsets with the improved vocoders—voice calls sounded about the same as with the earlier vocoders. What happened instead was that carriers chose to sell handsets embodying these new standards.

In order to accommodate the transition to a new vocoder standard, networks must be capable of supporting handsets supporting both standards. Consequently, a new handset that only supported the less efficient standard would work just fine—it would not "harm the network." Under the logic of Carterfone, there would be no reason to ban such handsets. Yet, overall efficiency is served if all new handsets on the network support both the old and new standards.

Receiver sensitivity and vocoder performance are two handset attributes that directly relate to network efficiency. Reduced receiver sensitivity reduces the transmission range from base stations—and requires more base stations for equivalent coverage. Vocoders that squeeze a conversation into half as many bits per second double the number of conversations that can fit into a wireless system—or cut in half the electronics required at the base station.

2.1.3 Other Handset Attributes That Affect System Capacity

Handset sensitivity is not the only handset characteristic that affects the amount of system resources that a handset will consume. There are a number of handset attributes (including receiver sensitivity, which I discuss above) that, if less than optimum, consume excessive system resources and thereby reduce the wireless system's capacity or coverage.

The first cellular technology used in the United States, AMPS, did not have the tight link between handset quality and system capacity that current systems exhibit. Indeed, to a first approximation, in that early technology system capacity was independent of handset quality. Unlike modern CDMA and OFDMA systems that serve multiple subscribers from a single transmitter/receiver pair, those early systems used a separate transmitter and receiver for each conversation. Transmitting more power to one handset did not diminish the power available to other handsets.

Modern wireless handsets often support web browsers and other connections to the Internet. Many of the standard rules for communicating over the Internet were designed under the assumption that communications capacity was relatively plentiful and inexpensive—consequently, standard Internet communications often contain substantial redundancy. Recognizing that this assumption is not always appropriate, the Internet standards community developed add-on capabilities that permit more efficient use of the communications links at the expense of additional processing in the handset and the network. The most well-known of these is Van Jacobson header compression, but there are several others.[6] Requiring such features in a handset lowers the handset's use of network resources.

2.2 Handset Attributes and Service Quality

Many of the capabilities or attributes of handsets affect not only the efficiency of the network but also the quality of the service delivered to subscribers. For example, a handset with poor sensitivity loses calls at locations where a phone with better sensitivity could continue the conversation. Similarly, speech delivered by a handset with a poor voice coding subsystem (vocoder implementation) or a low-quality speaker does not sound as good as speech delivered by a higher quality handset. Some handset impairments that harm other consumers or consume system resources have no direct negative impact on the user of the impaired handset.

Consumers are unable to distinguish between many handset limitations (such as poor sensitivity or weak uplink power) and related network limitations (such as poor

[6] V. Jacobson, "RFC 1144 - Compressing TCP/IP Headers for Low-Speed Serial Links," IETF 1990.

coverage). The symptoms of these particular network and handset impairments are exactly the same—dropped calls, regions of poor or no service, and poor voice quality on a call. Because consumers cannot readily distinguish between network weakness and handset shortcomings, consumers with poor handsets may mistakenly blame service providers for the resulting poor service. Wireless carriers concerned with protecting their reputation have an incentive to control the quality of the handsets used by their subscribers.

Handsets affect service quality in another way as well. Customers often call their wireless carrier for assistance in configuring their handsets or in dealing with service features. A customer using a handset that the helpdesk staff is not familiar with or does not have information on in their databases would pose unusual and difficult challenges—especially if the customer were trying to use one of the less-common features.

2.3 Network Standards Evolution

Wireless service providers in the United States have used multiple standards—AMPS, TDMA, iDEN, CDMA, GSM, WCDMA, CDMA2000, WiMAX and LTE—and have had to transition their systems from one standard to another. All cellular carriers had to shift from analog to digital. All U.S. wireless carriers continuously face such standards transitions—the problem is the need to manage the transition from one generation of technology to the next generation. For example, the GSM standard is being continuously upgraded—a new version is released every year or two. Each new release contains new capabilities some of which make networks more efficient. Providing customers with a mix of handsets incorporating the new standards is an important tool in making the transition from one standard to another.[7]

[7] It should be noted that some nations do not permit wireless carriers to move from one generation of technology to the next within their licensed spectrum. Rather, carriers in a specific band are locked into a specific technology. See http://stakeholders.ofcom.org.uk/consultations/spectrumlib/?a=0.

The more rigidly a nation controls the technology used in wireless, the weaker become the arguments for carrier control of handsets used with the carrier's network. At the same time, such rigid controls undercut the innovation process. It should be no surprise that the CDMA technology underlying all 3G system designs was developed under the flexible regulatory regime in the United States.

Note that individual consumers often have no incentive to buy new-technology handsets—the service delivered to new-technology and old-technology handsets is exactly the same. If it is the case that (1) the adoption of new-technology base stations and handsets is the efficient way to expand network capacity and (2) new-technology handsets are more expensive than old-technology handsets but offer similar performance, the efficient network/handset choice will not be made unless the carrier provides an incentive to consumers to use the more efficient handset technology. The usual theory of congestion pricing teaches that service price is one such incentive—the carrier could offer discounts to users who used the new-technology handsets in locations served by new-technology base stations during peak times. However, such pricing would run directly counter to consumer preferences for simple and predictable price schedules.[8] Another approach is for the carrier to subsidize the sale of new-technology handsets to those who are likely to make calls in areas served by the new-technology base stations. Tying and handset subsidies are good tools for ensuring rapid consumer adoption of new-technology handsets.

3 Wireless Handsets Are Not Like Telephones

Ordinary wired telephones might appear to offer a natural analogy to wireless handsets. However, wireless handsets present a great contrast to traditional telephone service and telephone instruments. Wired telephone service is a familiar, well-established service. Most consumers of wired telephone service take that service from an established carrier that is subject to public utility regulation. The transmission facility, the wires to the home, is separate from the instrument. It is relatively easy to distinguish between problems in the network and problems in the instrument—one can just unplug the instrument and plug in a known-good second instrument. If the second instrument works, then the problem is in the first instrument. If the second instrument also fails, then the problem is in the wires. As described in some detail above, wireless handsets use shared resources to provide service, and thus my use of an inferior wireless handset can degrade someone else's ability to get quality service.

[8] See "Internet Pricing and the History of Communications," A. M. Odlyzko. *Computer Networks* 36 (2001), pp. 493–517.

On the landline side, in situations in which there is no possibility that my use of a handset will interfere with someone else's use of the wired network, consumers can purchase telephone instruments that meet the FCC's Part 68 rules and connect those instruments to the wired telephone network via any standard jack. Home telephone instruments are connected to the larger telephone network by a pair of wires that runs from the home to the telephone company's central office.[9] For most telephone connections, that wire pair is a dedicated resource—used by only that one subscriber. If a subscriber's handset fails, say by shorting out the line or by creating terrible static on the line, only the subscriber's other extensions lose service. The harms created by a substandard instrument flow to the subscriber who purchases and controls that instrument but not to other subscribers.

But even on the landline side, in the case where the potential for interference exists because of use of a shared resource, no unbundling was ordered by the FCC. Party lines, rare today but once common in residential service, use a single pair of wires to serve two or more subscribers.[10] Thus, only one of the subscribers on a party line can make a call at any moment, and eavesdropping on the calls of others sharing the same line is easy. In 1981, the FCC initiated an inquiry into the feasibility applying its registration program to telephone instruments connected to party lines.[11] That inquiry concluded that it was not practical to require telephone companies to allow consumers to supply their own telephone instruments for use with party lines.[12] The FCC summed up its analysis saying,

> With as many as eight parties sharing a party line, improperly installed or malfunctioning terminal equipment could affect many more people than just the user of the equipment. Automatic answering machines, like telephones, would have to be designed to respond only to calls addressing the user of the machine.

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[9] This account is illustrative of the structure of modern wired telephone networks. Complicating elements, such as the use of remote terminals or load coils, that are not essential to the main point are omitted.

[10] Verizon's website states that C&P of West Virginia eliminated party-line service in late 1989. See http://www22.verizon.com/about/community/wv/information/info_history.html.

[11] FCC, "CC Docket No. 81-216. Commission invites comments on Notice of Proposed Rule Making amending Telephone Registration Program (Part 68) and institutes an inquiry into standard for business and residential wiring and party line service under Part 68," 85 FCC 2d 868, 1981.

[12] FCC, "CC Docket No. 81-216. Second Notice of Proposed Rulemaking and Order," 92 FCC 2d 1, 1982. The current FCC rules state "The rules and regulations apply to direct connection of all terminal equipment to the public switched telephone network for use in conjunction with *all services other than party line services*." See 47 CFR 68.2(a).

> Otherwise, they would operate whenever any party on the line were called, infringing on that other party's privacy and possibly causing the caller unnecessary billing. Automatic dialers, which present a slightly different but equally significant problem would require special circuitry to automatically relinquish the line on demand of another party. Such circuitry would be critical in emergency situations. Any damage by any such automatic device to a party other than the user could subject the user and/or manufacturer to considerable financial liability. These risks of third party harm, in addition to those associated with ANI failures and other network related faults, constitute a substantially increased array of potential harms than those generally associated with single party service. Our concern, then, is not only with the feasibility of developing, administering and implementing new rules, but with public safety as well.[13]

The fundamental difference between single-line and party-line phones is that, under most reasonable conditions, failures or impairments in a single-line telephone instrument will harm only the user of that telephone but failures or impairments in party-line instruments can readily harm others who share that party line.

The mistaken analogy of wireless handsets to common telephones is natural enough. However, such an analogy is deeply flawed, could easily mislead, and should be rejected.

4 Lessons for Competition Policy Analysis

The features and quality of a handset are inextricably intertwined with the quality of the wireless service and the capacity of the network. If John uses an inferior wireless phone—even if that inferior phone was state-of-the-art 5 years ago—he may deny service to Mary who is sitting next to him or may degrade service for other users within about a mile around him. Widespread use of inferior handsets would either substantially degrade wireless service—such as by increasing the number of coverage holes and dropped calls—or would require a substantial increase in the capital plant used by wireless carriers. In either case, consumers would suffer.

Economists have studied tying and bundling for decades and have identified circumstances in which such bundling serves efficiency and circumstances in which such

[13] 92 FCC 2d 37, footnote omitted.

bundling is anticompetitive and may harm consumers.[14] Most consumers find it convenient that right and left shoes are sold in pairs.[15] But, antitrust authorities are suspicious when monopolists tie competitive products with monopoly products and economists have identified circumstances in which tying or bundling can be anticompetitive.[16] However, the usual analyses of tying are inappropriate for wireless handsets. Handsets are both a *complement* to the network and a *substitute* for additional network elements.

Arguments that handsets must be competitively supplied—independent of the preferences of the network service supplier—fail to take into account (1) the tradeoff between handset capabilities and network capacity, (2) the coevolution of the network and handsets, and (3) the security needs that are served by locking handsets to networks.

4.1 Other Approaches to Handset Qualification

Of course, tying is not the only possible mechanism that carriers could use to assure that their customers use appropriate handsets. Possible alternative strategies include (1) a list of acceptable handsets, (2) testing consumer-supplied handsets for conformity to the carrier's handset standards, (3) pricing network services to reflect the relative network resource consumption of each handset, and (4) regulating handset technology so that all handsets in the market are "acceptable." However, each of these alternative strategies may pose significant practical difficulties.

The first alternative, carriers creating lists of acceptable handsets, poses a few practical difficulties. Public disclosure of the criteria for making the list could disclose sensitive competitive information—particularly information regarding network engineering and

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[14] See Tirole, Jean, "The Analysis of Tying Cases: A Primer." *Competition Policy International*, Vol. 1, No. 1, pp. 1–25, Spring 2005. Available at http://ssrn.com/abstract=702641, Carlton , Dennis W. and Waldman, Michael, "How Economics Can Improve Antitrust Doctrine towards Tie-In Sales: Comment on Tirole's 'An Analysis of Tying Cases: A Primer'." *Competition Policy International,* Vol. 1, No. 1, pp. 27–40, Spring 2005. Available at http://ssrn.com/abstract=702645

[15] However, the policy of bundling right and left shoes harms some consumers. I know of family with a child whose feet were, due to a birth defect, different sizes. Consequently, purchasing a useful pair of shoes required purchase of two bundled same-size pairs. The Internet has now made it possible for firms to supply unbundled shoes economically. See http://oneshoetwoshoe.net/ or http://www.oddshoefinder.com.

[16] In March 2004, the EU imposed a half-billion dollar fine on Microsoft and, among other acts, required Microsoft to offer a version of Windows without Windows Media Player. See IP/04/382, Brussels, 24 March 2004.

planned network evolution. A carrier's decision to remove a product from the list of approved devices could become contentious and the subject of allegations of abuse. Some reasonable criteria for making such a list, such as the ease of help-desk support, are subjective and could also become contentious. And, of course, such a list could itself be regarded as a form of tying. However, in spite of these difficulties some carriers have adopted such lists.

The second alternative, testing individual customer-supplied handsets for conformity to the carrier's specifications, would be impractical. Such testing requires specialized equipment, trained test technicians, and takes hours not seconds. Such testing would impose substantial transactions costs. And, of course, the criteria for acceptance and rejection could easily become contentious. The first alternative, creating a list of acceptable models, could also be based on testing but it would require testing only a few units—not every unit.

Pricing network services to reflect handset consumption of network capabilities would require adopting a radically different pricing model for wireless service—a pricing model that would be far more difficult for consumers to understand than the current pricing models that base prices on minutes of use, time of day, and gross variations in location.[17] Such pricing models would also introduce wider variations in service prices in a fashion beyond user control.[18] Even if such reformed prices were acceptable to consumers, there would still be the potential for contention over the pricing mechanism. One can easily imagine the suppliers of handsets that incurred higher network charges complaining that such charges were anticompetitive.

To sum up, each of the first three alternative strategies that I identified could impose significant transactions costs and would be subject to complaints that the mechanism was anticompetitive. Counterbalancing these costs would be any efficiencies created if

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[17] See Odlyzko, op. cit., for a discussion of consumer preferences for simple pricing structures.

[18] Consider a user standing on a sidewalk talking on a handset. After the user has been talking for a few minutes, a truck drives up, parks at the curb, and blocks the direct path from the handset to the base station. With the direct radio path blocked, the handset's consumption of network resources doubles. Reflecting such unpredictable and uncontrollable increases in resource consumption in prices would confuse and probably anger consumers.

handsets with unique capabilities or that were strong complements to the network became available in the market.

To take advantage of such efficiencies, several years ago the wireless service providers developed programs for certification of various types of special purpose gear to be used on their networks. One example of such programs is given by AT&T's Specialty Vertical Device Program.[19] On July 13, 2010, the AT&T website showed that AT&T had certified 577 devices; two and a half months later (September 28) the website listed 615 devices.[20] The list of AT&T-approved devices includes wireless modules that permit a designer to build a device without having to design the underlying radio subsystem. AT&T's website lists 11 suppliers of approved modules and provides a list of 66 approved modules.[21] Interestingly, the earliest approval date on that list is 8/29/2005—roughly a year and a half before Professor Tim Wu published his article on wireless net neutrality.[22] The most recent approval date is 8/30/2010.[23] One should also note that the availability of such modules makes it easy for a designer of user terminals to develop a specialized device and bring it to market. Modules and USB-stick wireless modems provide a standardized basic network interface—much as the copper loop does in the wired world. I find it hard to imagine that a wireless Carterfone policy could provide consumer benefits that would significantly exceed those delivered by the availability of a selection of modules.

AT&T does not charge for testing such equipment. AT&T does impose technical requirements that improve network efficiency such as requiring that voice devices must support the AMR vocoder and requiring that devices provide acceptable reception of weak signals. As the discussion above has shown, these two requirements are among

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[19] See http://www.att.com/edo/en_US/pdf/HWDevelopmentBestPractices.pdf. Verizon's similar program is described at http://opennetwork.verizonwireless.com/getDeviceCertified.aspx.

[20] See http://developer.att.com/developer/device_list.jsp?filter=18800162.

[21] See http://developer.att.com/developer/index.jsp?page=ncpContent5&projectId=prj61017&project=prj61017&id=6.3_v1_4700150.

[22] That device is the Sierra Wireless Q24 Classic. Professor Wu's paper is dated February 2007. See http://www.newamerica.net/files/nafmigration/WorkingPaper17_WirelessNetNeutrality_Wu.pdf

[23] That device is an Enfora Enabler module. See www.enfora.com.

those that one would expect to see if AT&T were trying ensure that user devices did not consume inordinate amounts of network resources.

The fourth alternative, regulating handset technology, would solve one problem, but at the expense of imposing substantial constraints on the dynamic evolution of the industry. The FCC explicitly decided against this approach when they adopted their policy of technical flexibility for wireless standards. Technical flexibility is regarded by many as an enormous success.

5 Concluding Thoughts

Phrases like *net neutrality* and *cellular Carterfone* sound good—neutrality has positive connotations, and it is widely accepted that the FCC's *Carterfone* decision served consumers well in the wireline world.[24] However, such concepts have to be reviewed carefully as artful choice of terms and misplaced analogies may mislead about such policies ultimate impacts on consumers. As demonstrated in this paper, the tight integration of wireless terminals with wireless networks, as well as the myriad decisions that go into wireless device design, have served the interests of consumers by improving wireless service and enabling new services.

About the Author

Dr. Charles L. Jackson is an electrical engineer who has worked extensively in communications and wireless. He has been both a digital designer and a system programmer. He works as a consultant and as an adjunct professor at George Washington University, where he has taught graduate courses on computer security, networking and the Internet, mobile communications, and wireless networks. Dr. Jackson consults on technology issues—primarily wireless and telecommunications. Dr. Jackson served three terms on the FCC's Technological Advisory Council. He previously worked at both the FCC and the House Commerce Committee. He holds two U.S. patents. Dr. Jackson received his PhD from MIT.

[24] It is less well recalled that that FCC decision did not occur until well after the D.C. Circuit Court of Appeals had made it clear in its 1956 Hush-A-Phone decision that the law required the FCC to follow the basics of Carterfone. Acoustically coupled modems and fax machines were available before the Carterfone decision—Carterfone did not provide the environment in which they were invented.

Wireless Transport Separation – Technical Facts

July 15, 2010

This technical paper attempts to address the difficulties associated with the suggestions made by the FCC in its recently released Notice of Inquiry that the "Internet connectivity component" functionality of wireless networks be separated and treated differently for regulatory purposes.[1] In the Notice of Inquiry, the FCC proposes to regulate the data transmission, or transport component of the Internet as being subject to Title II of the Communications Act while leaving broadband Internet information services under Title I. In essence, the proposal creates a demarcation between the transport of broadband data and IP communications services. From a technical perspective, IP information and the underlying transmission and/or transport are highly integrated together as evidenced by today's Internet standards and network technology. For current wireless networks, the two are not easily or naturally separated without significant technical risk, cost and complexity. Moreover, next generation wireless technology, with its need for backward compatibility and greater capacity/throughput, makes such a separation even more difficult. The FCC's proposed regulatory framework would undo many of the technological advances and innovations that modern IP architectures have brought to the industry and to consumers.

Historical Implementation of Wireless Standards. Today's wireless systems, 2G, 3G and 4G technologies, have unique architectures that are increasingly integrated at the transport and communications layers than ever before to provide for network efficiency and management of scarce radio frequency and spectrum resources. First generation analog wireless systems began with a simple but effective architecture that supported interconnection of a mobile phone to a Base Station/Cell Site that in turn was connected to a Mobile Switching Center and from there to the PSTN.[2] While early systems relied upon common channel signaling protocols[3] that were separate from the network transport, even the early analog wireless systems relied upon integrated signaling/information services and transport in the air-interface through FSK[4] signaling combined with FM analog voice transmission on the same channel (for maximum spectral efficiency). Second generation systems, such as GSM and CDMA, introduced the ability to support both circuit-switched and packet-switched data services, where services such as SMS[5] were made

[1] *See Framework for Broadband Internet Service*, GN Dkt. No. 10-127, *Notice of Inquiry*, FCC 10-114 (rel. June 17, 2010) ("Notice of Inquiry").
[2] PSTN – Public Switched Telephone Network
[3] Example: SS7 – Signaling System Number 7, Common Channel Signaling Protocol Standard
[4] FSK – Frequency Shift Keying data transmission technique used in EIA/TIA-553 Standard
[5] SMS – Short Message Service texting

possible by the integrated nature of transport and information/signaling structures. Driven by limited resources and ever increasing demand for wireless broadband services, 3G and 4G wireless networks increasingly must integrate the broadband transport function into the air-interface as well as all aspects of the network architecture.

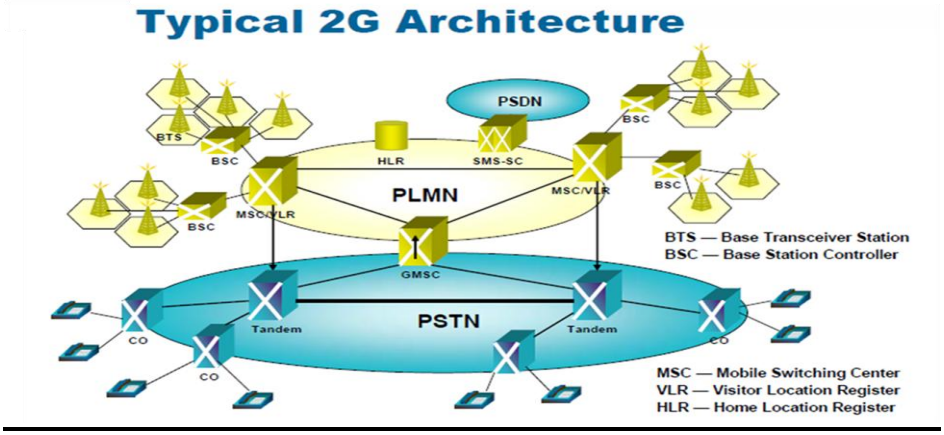
For 3G networks (such as UMTS, EV-DO, etc.), there is IP network management, adaptation and conversion (e.g. WAP[6] gateways) associated with the mobile environment to provide IP services between the wireline Internet and the mobile user. Finally, for next generation wireless standards ("4G" such as LTE and WiMAX), the network architecture is new and different from 3G and provides end-to-end IP services through the implementation of the Enhanced Packet Core (EPC).[7] Each evolution of wireless interface standards has increased the integration of the network and transport layers to drive greater efficiencies and better performance for consumers.

The FCC acknowledged before the U.S. Supreme Court in the "Brand X" case that in broadband networks these functions are so integrated that broadband transport was not a separate service offering.[8] In the case of wireless broadband, the integrated nature of the network architecture is more an imperative now than ever before as the industry embarks on the path to 4G technology.

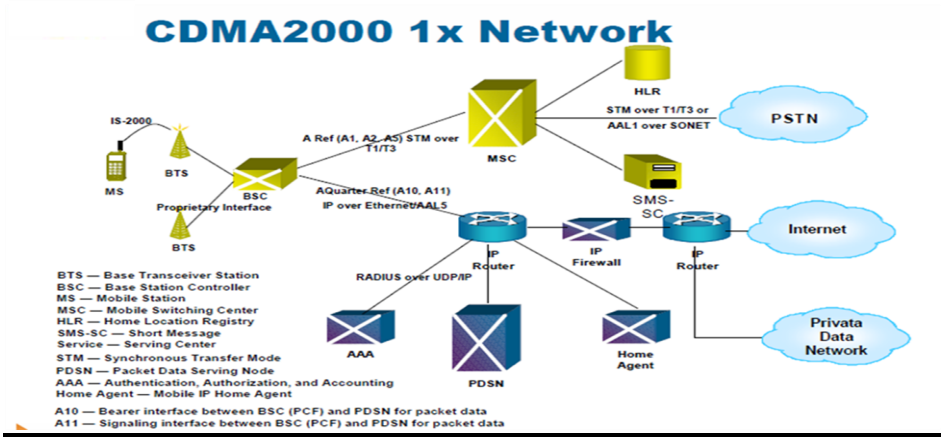
Wireless Network Architecture Background. To ensure the best experience for subscribers, mobile broadband network architectures rely upon radio frequencies to communicate with the network as an integrated and shared resource among all users and applications. The radio base stations that communicate with a mobile broadband device provide for network management and congestion and admission control, and support seamless handover from one base station to the next as the device moves across the network, across service providers and across regions – sometimes at very high speed as in the case of a moving vehicle. Unlike DSLAMs that are used in the wireline network infrastructure,[9] radio base stations manage wireless coverage within a prescribed geographic area and in coordination with their peer radio base stations,radio network controllers, mobile switching centers, packet data switching nodes, and gateways. The figures below detail the network architecture in GSM[10] and CDMA networks.[11]

[6] WAP – Wireless Access Protocol
[7] 3GPP Standards for the Enhanced Packet Core
[8] *Nat'l Cable Telecomms. Ass'n v. Brand X Internet Servs*., 545 U.S. 967 (2005)
[9] DSLAM – Digital Subscriber Line Amplifier Module
[10] GSM – Global System for Mobile
[11] CDMA – Code Division Multiple Access

GSM Architecture



CDMA Architecture



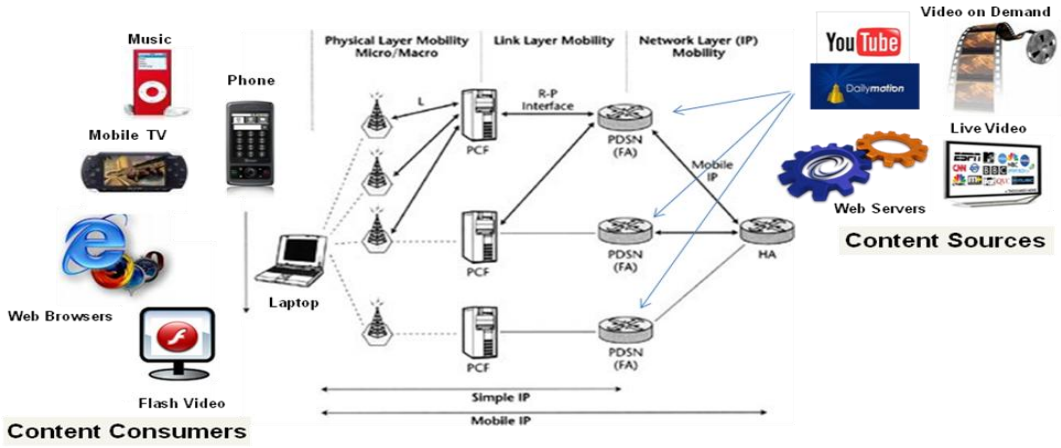
Both figures demonstrate the variety and complexity associated with wireless networks as well as the tight coupling of both transmission/transport and "computing functionality."[12] As an example, one can look to the Handover and RF Power Management protocols that are defined in 3GPP and 3GPP2 Standards and their linkage to how IP protocols interact with mobile devices as they traverse the network to support such capabilities as VoIP[13] seamlessly with existing GSM or "1X" circuit switched services.

The figure below demonstrates how tightly coupled the functions are in the case of IP content.

[12] FCC, A THIRD-WAY LEGAL FRAMEWORK FOR ADDRESSING THE *COMCAST* DILEMMA, Austin Schlick, General Counsel, May 6, 2010

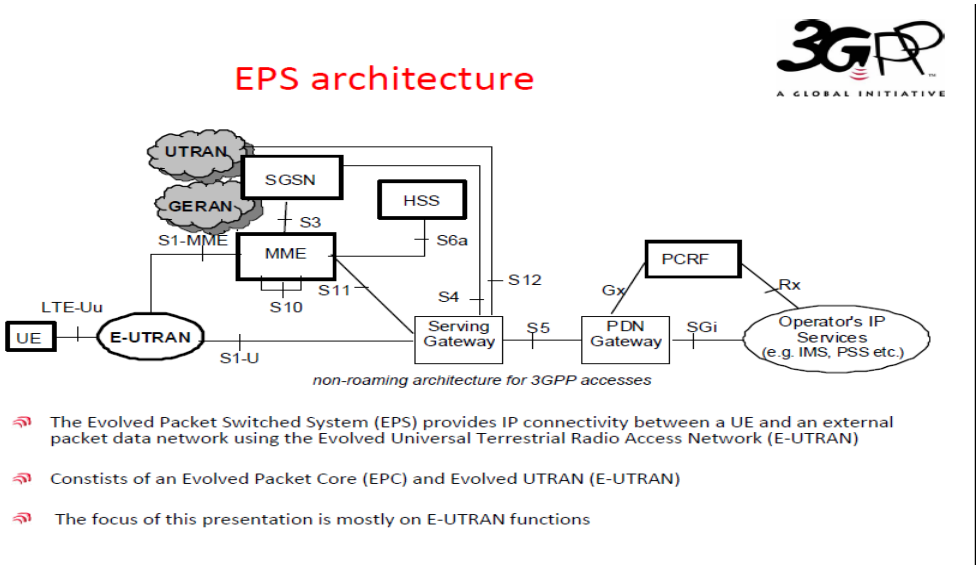
[13] VoIP – Voice over IP

Handover and IP Content



As mobile devices move from Base-Station to Base-Station, or from network to network, Internet content must continue to flow seamlessly from the Internet content source to the end-user's mobile device. Standards-based protocols are used to support mobility based on Mobile IP and Simple IP technology. While the Internet content application and wireline Internet have no "knowledge" of the Handover and RF Channel Management functions performed by the wireless network, the mobile network interacts with the IP content stream to deliver the information seamlessly and reliably without encumbering the application or the wireline Internet. It does so through integrated knowledge of the transport environment and processing associated with the information stream. In other words, mobility interactions with the mobile device and IP Content streams are all carried by IP data packets. To separate them into multiple and redundant data packets would create significant inefficiency and disruption and would ultimately impact the overall performance of the network. Moreover, it would require new standards efforts – a process that typically takes 18 to 24 months to complete.

The reality of the situation is made even more profound with the introduction of 4G technology and the Enhanced Packet Core (or EPS) as shown by the reference architecture below from the 3GPP Standards.



As demonstrated by the above, the wireless network is going through a significant change in technology and end-to-end architecture. The EPC represents a new generation all-IP architecture that will coexist with the previous systems for years to come. In addition to supporting the Handover and RF management functions of its predecessors, the new architecture must support seamless interoperability with legacy systems as well as increased bandwidth and greater overall network capacity.

The approach commonly used to accomplish interoperability relies upon such techniques as protocol interworking, QoS, Traffic Shaping, Mobility Congestion/Traffic Management, Deep Packet Inspection (DPI), and a host of network management algorithms that serve to make the transition from one technology to the next, and from one architecture to the next – seamless and transparent. As noted earlier, the wireless industry very early on chose an integrated architecture to maximize efficiency and end-user experience. To force a split in the architecture where, for example, an LTE/WiMAX system based on a non-integrated transport has to interwork with an existing 2G/3G system, would cause inordinate complexity and technical risk; particularly when the scope and scale of the networks in question approach on the order of 100 million subscribers. Not only would the level of protocol conversion consume capacity and create a “bottle-neck” in the network architecture, but the notion of Internet “peering” would be lost by forcing a separation of the transport in one part of the network. To retroactively consider re-architecting 2G/3G networks to separate the transport layer would be prohibitive in scope, scale and technical risk.

Further, quality of service issues such as latency and jitter become even more critical as networks scale to support the mix of services that rely on full-motion video, broadband data and end-to-end VoIP applications. These applications have driven network traffic to a point where today’s network volume is measured

in exabytes.[14] As a result, during heavy traffic demand packet prioritization, congestion management and the ability to respond in real-time to peak traffic demand become extremely critical to network performance and the ability to deliver the highest quality end-user experience. The EPS architecture and standards were designed around the need to greatly simplify the 4G architecture such that end-to-end packet flows can be managed in an integrated fashion, where the network's visibility to the traffic is clear. The network can thereby quickly respond to increased demand, while at the same time interoperate with other radio networks such as 2G/3G networks and Wi-Fi systems. As traffic demand continues to increase, wireless networks will need to manage available resources more effectively than ever across Wi-Fi, 2G, 3G and 4G networks and technologies. To attempt to separate transport and force an architectural split in the network will not only create unnecessary complexity and technical risk, but will negatively affect the network's ability to manage its resources to the benefit of end-users.

Conclusion. The principles of coexistence, interoperability and seamless service regardless of technology (Wi-Fi, 2G, 3G or 4G), and advanced network architectures to support IP content are placed at risk by creating a demarcation between transport and data processing. Such a change would require not only changing industry standards that have evolved over decades of work by leading engineers and scientists, but would also cause architectural disruptions and create deleterious inefficiencies with the fundamentals of wireless networks.

In sum, 3G and 4G wireless networks increasingly integrate the broadband transport function much more so than the cable and wireline network architectures. The proposed attempt to identify the "Internet connectivity component" of a wireless network (as compared to the rest of the Broadband Internet service) cannot be accomplished with today's wireless networks or standards.

[14] Exabyte – 10^{18} bytes of data

I, John Marinho, declare under penalty of perjury that, to the best of my knowledge, the foregoing is true and correct.

_____
John Marinho

Date: July 15, 2010

Wireless Broadband, Tiered Services and Network Management

September, 2010

This technical paper attempts to address the need for network management in the context of wireless broadband tiered services and the ongoing need to support traffic engineering, network capacity optimization and quality-of-service. The FCC, in its recently released "Further Inquiry Into Two Under-Developed Issues In The Open Internet Proceeding"[1] Public Notice, cites examples of wireless carriers introducing tiered pricing plans for different levels of data consumption and posits whether these offerings "reduce [the] mobile broadband provider's incentives to employ more restrictive network management practices." Tiered pricing plans for different levels of data consumption do not mitigate the requirement for network management functions. The need to engineer overall system capacity and manage the corresponding data traffic flow is a function of real-time demand for network resources, peak traffic flows on the network and the need to balance the overall system load to deliver quality-of-service to consumers. Differing tiers of service address periodic limits (often monthly) on overall consumption (minutes-of-use or Megabytes of Data), but do not correspond to the real-time peak demand and load that may appear to a base-station or network element.

Further, in the case of wireless broadband different tiers of service drive increased requirements for network management functions due to the added complexity of managing common network resources across the various tiers, and across various networks and technologies – as in the case of roaming.[2] Modern broadband wireless networks introduce more demands due to applications with

[1] *See "Further Inquiry Into Two Under-Developed Issues In The Open Internet Proceeding", GN Docket No. 09-191, WC Docket No. 07-52, September 1, 2010*

[2] *Traffic Engineering, Modern Broadband Networks - Robert Li Kam Wa, Bruno Nardelli , Rice University, 9 Feb 2009*

differing QoS requirements, traffic flows that are not amendable to flow control (*e.g.* VoIP, video), and long-tail traffic patterns (large variety). In response to the increased demands service providers implement more sophisticated network management functions to benefit all end-users regardless of tiered service implementation or structure, since they function as a common resource that is shared across the network not unlike the air-interface and other common network resources.

Wireless Network Management. The reality of today's environment is that the basic engineering principles of network management are more critical than ever before to the everyday operation of wireless broadband networks. Regardless of whether a wireless broadband service provider implements service tiers or not, network management functions must deliver on the notion of end-user traffic "control and management" and "congestion control/avoidance" to provide for a defined Quality-of-Service (QoS) or end-user experience. Network management is used to ensure that quality-of-service is maintained as demand on the network skyrockets or peaks, to protect against bad actors/bandwidth hogs, to prioritize network management traffic (*e.g.*, routing tables), and to maintain network security (*i.e.* contain the proliferation of spam, spyware, worms and other "malware"), and more. The network management tools that are commonly employed by the service providers include overall QoS treatment, traffic shaping, the use of Virtual Private Networks (VPNs), access control lists, Content Delivery Networks (CDNs), and video experience management.

As a common example, QoS operates based on the ability to classify and mark IP data packets with a specific priority denoting a requirement for class of service from the network. Based on the specific priority, packets are scheduled and assigned to network resources (*e.g.* one of multiple network queues, particular wireless air-interface technology or spectrum band) based on classification, possibly for expedited treatment throughout the network. In aggregate the volume of traffic and priority drives the estimated traffic bandwidth need and requirement for network resources to provision the corresponding capacity for the

anticipated IP packet demand plus any overhead – not the tier structure associated with data consumption. The rationale for so doing is the basic network engineering objective to provide fair access to network resources for all legitimate end-users through the efficient and timely allocation of resources such as the air-interface. The result being that, not only does QoS ensure that the network's performance meets end-user expectations, but also it has been shown to provide the added benefit of more than a two-fold network capacity and performance improvement over networks that do not support QoS.[3] So the benefit of QoS is shared among all users and service tiers in terms of improved overall throughput, capacity and experience. However, it is important to recognize that QoS and network management functions, while having the same objective, exhibit broad variety across network platforms (*e.g.* wireline, wireless) because the available resources are different and unique to the network environment, traffic demand, service capability and underlying technology (*e.g.* network queues, radio spectrum, radio technology channel type).

Wireless Technologies. Today's wireless systems, 2G, 3G and 4G technologies have unique architectures, capacity constraints and throughput differences relative to network efficiency and the management of scarce radio frequency resources and spectrum. First generation analog wireless systems began with a simple but effective architecture and used analog FM radio technology to support voice interconnection of a mobile phone to a Base Station/Cell Site that in turn was connected to a Mobile Switching Center and from there to the PSTN.[4] While the architecture remained very close to first generation systems, 2G technology introduced the ability to support data network protocols in a shared fashion across the air-interface channel using a TDMA[5] technique where voice and data communications share network resources (*i.e.* air-interface time-slots). The introduction of 3G technology significantly increased the capacity and data rate capabilities of the air-interface, and did so through the

[3] A Discussion with the FCC on the Open Internet, Cisco, FCC Workshop, December 9, 2009
[4] PSTN – Public Switched Telephone Network
[5] TDMA – Time Division Multiple Access

use of CDMA[6] technology where air-interface resources are shared among users and applications based on the assignment of spread-spectrum codes rather than time-slots as in the case of 2G and TDMA. In going beyond 3G, the introduction of OFDMA[7] was seen with the introduction of 4G and the LTE[8] and WiMax Standards. As shown in Figure 1 below, the data rates associated with each evolution of technology significantly improved the overall capacity and throughput of wireless networks. As system technology and capacity improved tiered voice services became commonplace. In the same way that service providers in the early days of wireless introduced tiered voice services (pricing plans based on consumption of minutes on the network), the industry has seen a similar approach being implemented by some service providers as it relates to broadband data. Nonetheless, the need for network management functions has continued to grow significantly with the introduction of each new technology, and as was seen with the early days of voice tiered services, tiered data services based on consumption will not mitigate the need to manage the complexity associated with the different technologies and network architectures that today continue to coexist.

[6] CDMA – Code Division Multiple Access
[7] OFDMA – Orthogonal Frequency Division Multiple Access
[8] LTE – Long Term Evolution, 3GPP Standard

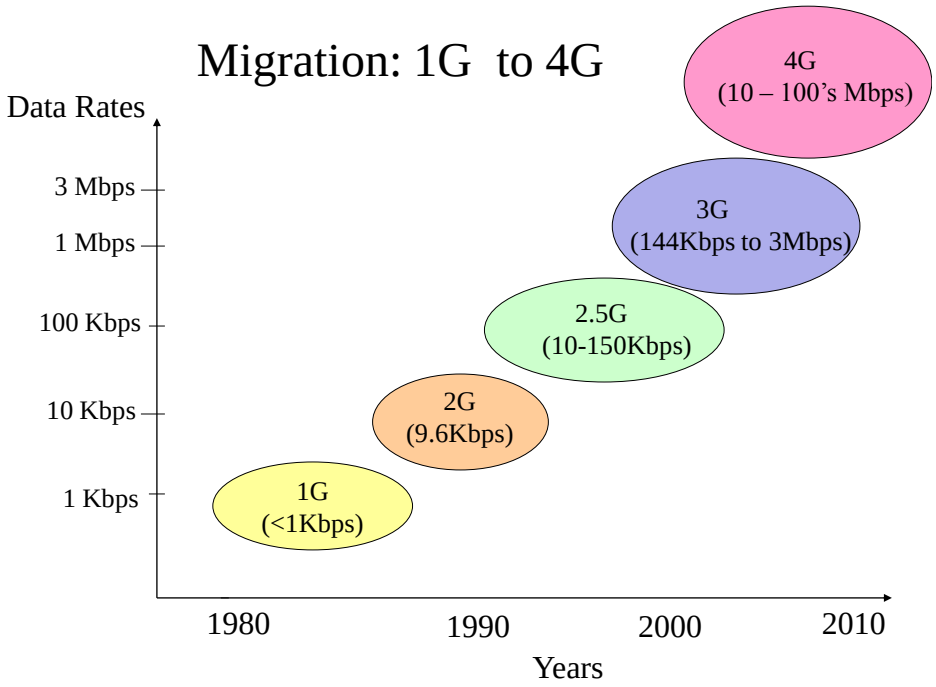


Figure 1

Wireless Network Architecture. Mobile broadband network architectures rely upon radio frequencies to communicate with and carry traffic into the network as shown in the figures below. The radio base stations that communicate with a mobile broadband device provide for network management and congestion and admission control, and support seamless handover from one base station to the next as the device moves across the network, across service providers and sometimes across regions – sometimes at very high speed as in the case of a moving vehicle. Radio base stations manage wireless coverage within a prescribed geographic area and in coordination with their peer radio base stations and radio network controllers, mobile switching centers, packet data switching nodes, gateways, and other network elements, as shown in the figures below:

GSM Architecture

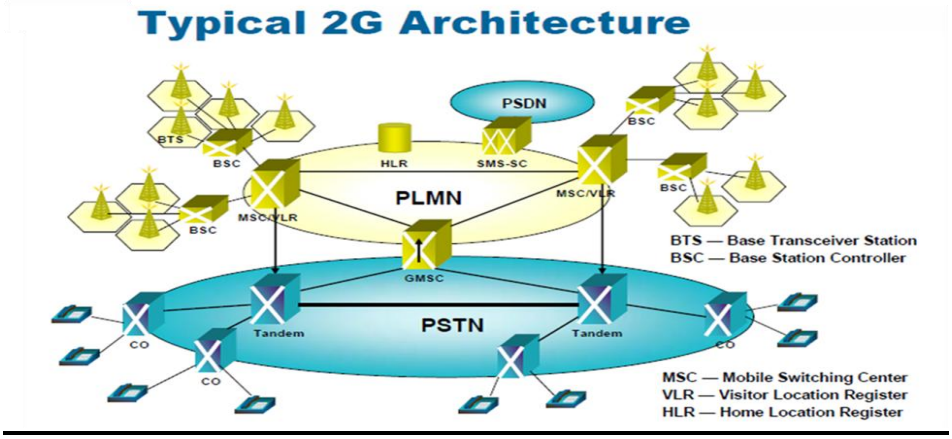


Figure 2

CDMA Architecture

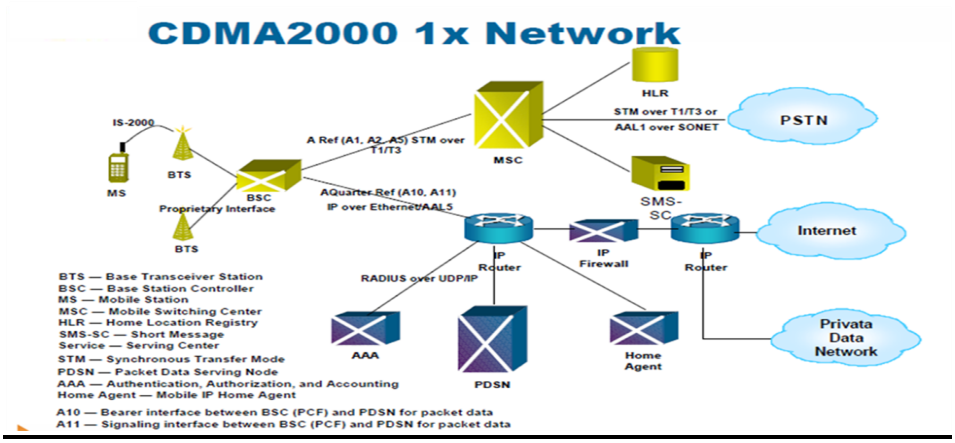


Figure 3

Both figures demonstrate the variety and complexity associated with wireless networks as well as the requirement to support network management functions. As an example one can look to the Handover and RF Power Management protocols that are defined in 3GPP and 3GPP2 Standards and their linkage to how resources must be managed as mobile devices traverse the network to support such capabilities as VoIP[9] seamlessly with existing GSM or “1X” circuit

[9] VoIP – Voice over IP

switched services. The figure below demonstrates the Handover scenario for IP Content and again highlights the importance of network management.

Handover and IP Content

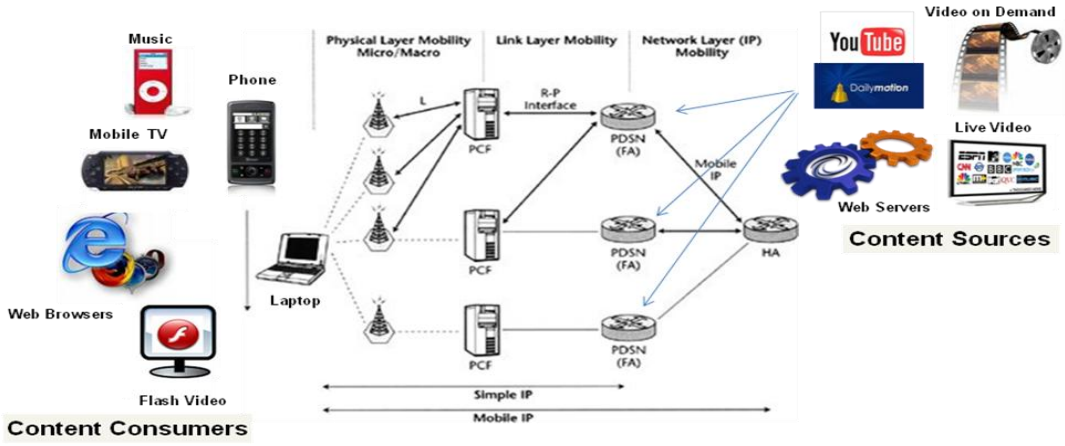


Figure 4

As mobile devices move from Base-Station to Base-Station, or from network to network, Internet content must continue to flow seamlessly from the content source in the Internet to the end-user's mobile device. Standards-based protocols are used to support such mobility based on Mobile IP and Simple IP technology. While the Internet content application and wireline Internet have no "knowledge" of the Handover and RF Channel Management functions performed by the wireless network, the mobile network interacts with the IP content stream so as to deliver the information seamlessly and reliably without encumbering the application or the wireline Internet. Regardless of tiered services, network management algorithms serve to make the transition from one technology to the next, and from one architecture to the next – seamless and transparent. As noted earlier, the wireless industry very early on implemented network management functions to maximize efficiency, capacity and end-user experience. To eliminate network management functions based on tiered data consumption would cause inordinate complexity and technical risk; particularly when the scope and scale of the networks in question approach on the order of 100 million subscribers. Not only would the level of data capacity demand become disproportionate and create an imbalance in the network, but as networks scale to support the mix of

services that rely on full-motion video, web and end-to-end VoIP applications, network management becomes critical to support these services across the various tiers. Today network volume is measured in Exabytes[10] and as a result packet prioritization, congestion management and the ability to respond in real-time to peak traffic demand become extremely critical to the networks performance during heavy traffic demand and the ability to deliver the highest quality end-user experience. Network management is critical to effective end-to-end packet flow performance, where the network's ability to respond quickly to the increased demand; while at the same time interoperating with other radio networks such as 2G/3G networks and WiFi systems is essential. As traffic demand continues to increase wireless networks will need to manage available resources more effectively than ever before across WiFi, 2G, 3G and 4G technologies. To replace or supplant traditional network management functions based on tiered services would compromise overall network performance, increase technical risk and network complexity, and reduce the available capacity to support end-user demand.

Conclusion. The principles of traffic engineering, interoperability and seamless service regardless of technology (WiFi, 2G, 3G or 4G), and advanced network architectures to support IP content are placed at risk if tiered pricing plans for different levels of data consumption are considered as a replacement for network management functions. The need to manage overall system capacity and manage the corresponding data traffic flow is a function of real-time demand for network resources, the need to manage peak demands on the network to balance the overall load and response to users in a fair and equitable manner that corresponds to quality-of-service metrics. The institution of tiered use models by wireless carriers may help alleviate some network congestion, but cannot serve as a substitute for management of wireless network spectrum resources.

[10] Exabyte – 10^{18} bytes of data